# FIRST AID TO THE INJURED
AND
# TRANSPORTATION OF THE WOUNDED.

# FIRST AID TO THE INJURED, AND TRANSPORTATION OF THE WOUNDED.

## A HANDBOOK FOR THE NAVY AND NAVAL MILITIA.

PROCEEDINGS OF THE U. S. NAVAL INSTITUTE, NO. 63.

---

The U. S. Naval Institute will publish as a regular number of the Proceedings, a valuable work entitled as above, and profusely illustrated, consisting of six lectures, delivered to the Naval Cadets of the First Class, at the Naval Academy, by Henry G. Beyer, M. D., Ph. D., M. R. C. S., Passed Assistant Surgeon, U. S. Navy, Instructor in Physiology and Hygiene, Naval Academy, Annapolis, Md.

The publication will be ready for issue early in September, 1892. 8vo form.

| | |
|---|---|
| Price (in paper) - - - - | 75 cents per copy. |
| " (in flexible cloth) - - | $1.00 " |
| " (in flexible leather) - - - | 1.25 " |

The usual trade discount. As the edition will be limited, it is suggested that orders for copies be given in good season.

Address,

SECRETARY & TREASURER,
U. S. NAVAL INSTITUTE,
ANNAPOLIS, MD.

Henry G Beyer, see page 343

Vol. XVIII., No. 3. 1892. Whole No. 63.

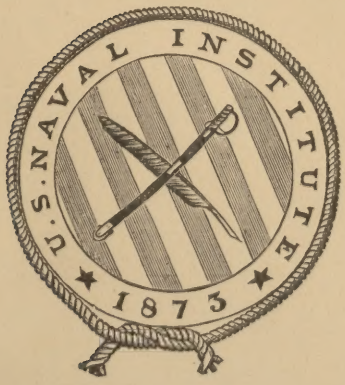
# PROCEEDINGS

OF THE

UNITED STATES

# NAVAL INSTITUTE.

VOLUME XVIII.






EDITED BY THE BOARD OF CONTROL.

PUBLISHED QUARTERLY BY THE INSTITUTE.

ANNAPOLIS, MD.

PRESS OF THE FRIEDENWALD CO.
BALTIMORE, MD.

*The writers only are responsible for the contents of their respective articles.*

# CONTENTS.

# THE PROCEEDINGS

OF THE

# UNITED STATES NAVAL INSTITUTE.

**Vol. XVIII., No. 3. 1892. Whole No. 63.**




U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

## FIRST AID TO THE INJURED, AND TRANSPORTATION OF THE WOUNDED.

Six Lectures delivered to the Naval Cadets of the First Class at the Naval Academy during the Winter of 1892.

BY HENRY G. BEYER, M.D., PH.D., M.R.C.S.,
*Passed Assistant Surgeon, U. S. Navy, Instructor in Physiology and Hygiene, Naval Academy, Annapolis, Md.*

CONTENTS.

*List of Books referred to in the Preparation of the Foregoing Lectures:*

Dr. Friedrich von Esmarch, Die erste Hülfe.

Dr. R. von Mosetig-Moorhof, Die erste Hilfe.

Osborn, Sam., F. R. C. S., Ambulance Lectures.

Porter, J. H., Surgeon-Major, and Godwin, C. H. Y., Brigade-Surgeon, The Surgeon's Pocket-Book.

Dr. Paul Rupprecht, Die Krankenpflege.

Smart, Charles, Major and Surgeon, U. S. Army, Handbook for the Hospital Corps of the U. S. Army.

Dr. Bowditch Morton, First Aid to the Injured.

Medical and Surgical History of the War of the Rebellion, Medical Volume, Part III, prepared by Charles Smart, Surgeon-Major, U. S. Army.

# LECTURE I.

## INTRODUCTION.

The purpose of these lectures and the demonstrations which will follow them is to give you that knowledge and training which will enable you to administer to your comrades whatever help they may need when injured, and to do it intelligently and with perfect safety.

The desire to aid an injured person and to succor a fellow-creature in misfortune is an attribute of every good man and woman. An acquaintance with the principles of "First Aid to the Wounded," therefore, ought to form part of their education, but it is to soldiers and sailors more especially, who are trained to expose themselves to the dangers of being wounded or otherwise injured, to whom this knowledge seems particularly desirable.

It is, furthermore, intended in this course of instruction to impress your minds with some of the leading and fundamental principles of hygiene, a knowledge of which will enable you to do much toward the prevention of infectious diseases among you, or, in case of an actual outbreak of an epidemic of whatever kind of disease, will at least form a safe guide for your conduct while it prevails, giving you a better chance of escape than you otherwise would have.

Most all of the civilized nations, after having become convinced, through the accumulation of unmistakable historical statistics, of the enormous death-rates occurring from preventable diseases in an army in the field or wherever many persons are closely housed together, as well as of the great benefits derived from a knowledge on the part of the soldiery of "First Aid to the Injured," and the principles of hygiene, have caused such instructions to be made compulsory.

In Germany, England and France instruction in First Aid is given to the laity; thus it is estimated that during the year 1887 40,000 persons, men and women, received this instruction in Germany; during the same year, in England, over 100,000 persons

passed their examinations after having received the required instruction under the auspices of the great St. John's Ambulance Association, of which Capt. John Furley is the head. It is, no doubt, well known to you that the Red Cross Association is doing similar work in this country, and that thousands receive this instruction through the benevolent efforts of this truly grand association, annually.

For purposes of illustration allow me to cite a few instances which tend to show more clearly than this mere statement the wisdom of these measures. Right at the beginning of the war of 1870--71 between Germany and France, 30,000 men, on the German side, or one whole army corps, were suddenly disabled on account of their not having been supplied with proper shoe-gear, and consequently they were unable to take part in the first battles. Such a calamity might have been sufficient to turn victory into defeat.

One such instance is quite sufficient to show you the great importance of proper attention being paid to the hygiene of clothing during the movements of troops from place to place. Other instances might be quoted illustrating the same disastrous results with regard to insufficient and imperfect food supplies, poor or insufficient water, etc.

But the most striking figures, by far, we obtain from the records of the mortality from infectious diseases in the different campaigns. For instance, in the war of the Crimea the French troops, which were numerically the strongest, lost 20,240 men from arms and 70,375 from infectious diseases, a proportion of 1 : 3¾; the English troops lost 1761 through arms and 16,297 from disease, a proportion of 1 : 9; and the Russians lost 30,000 through arms and 600,000 through disease, or 1 : 20. In short, whole armies have been conquered and destroyed by the enemy disease before coming into actual contact with their enemy under arms, and the modern general of an army corps or admiral of a fleet can no longer disregard the practical value, the far-reaching importance of sanitary measures properly carried out and watched over by competent men. In the war just spoken of, if the mortality rate between the English and French troops is compared during the different periods of the war, the following most interesting results are obtained with regard to this point.

During the first winter the English lost 10,283 and the French

lost 10,934 from the same cause, although the latter were four times as numerous as the former. During the following winter, however, the English lost 551, while the French lost 21,182 men. Corresponding to the numerical strength of the armies, the French ought to have lost only four times as many as the English, but instead they lost forty times as many. Consequently the sanitary condition of the French army must have been ten times as bad as that of the English army. The question, now, was asked and discussed all over the civilized world as to how it came that such a discrepancy in the mortality rate occurred in two armies which were exposed to the same identical climatic conditions, inhabiting, as they did, the same land and moving side by side, both being supplied with equally good physicians and surgeons? The answer was easily found in the bitter complaints of French army surgeons of their inability to get their sanitary measures carried out, while the English surgeons were supported and supplied by their government, which spent fifteen millions of francs to enable them to carry out properly the measures which they recommended.

During our own civil war, it is estimated that the actual mortality in our armies from May 1861 to June 30, 1866, was 44,238 killed in battle and 260,131 that died from disease or the wounds received, after the battle. The enormous pension list which at present burdens this nation, although willingly borne by a grateful people, will never again assume its present gigantic proportions, if our army surgeons can carry out their present magnificent sanitary organization in the event of another war.

A great many appalling examples of bad hygiene and sanitary management might be cited from the records of our own wars, and are, no doubt, present in the minds of many survivors, for it is said, and with a good show of accuracy and truth, that since 1776, and although claiming to be a peaceful nation, we have lost more men in actual warfare than any nation of Europe. But the above few instances must suffice for our purpose, if otherwise we would not transgress the limits and scope of simply giving you some of the reasons for the dissemination among you of that knowledge without which no man, either educated or not, can possibly appreciate what sanitary suggestions mean, or have an idea of how to carry them into effect in the light of modern improvements. Nor does the necessity for giving this instruction to the officers and men in

our Navy grow less apparent on account of their number, which we all know is, comparatively speaking, limited. It would appear, on the contrary, that the smaller an army or navy, the more valuable is each individual life in it, and consequently the more economical ought we to be with the health and strength of each individual man. The people of the United States have all the more right to expect their army and navy to be a model of perfection in every respect and of their kind, as the numbers composing them are small.

New guns and new machinery have been invented for the destruction of human life; new ships are rapidly taking the place of the old ones; new drills and tactics have had to be devised to meet the requirements of modern warfare. Let us not forget to make preparations to succor the real motive power that works these modern fighting machines in times of need! Quite in keeping with the spirit of the second half of this nineteenth century, the most remarkable advances have been made in the treatment of wounds and diseases in general. In order to keep abreast with these modern advancements and improvements, it has become necessary in the Navy that the simple and always useless instruction of the men in the use of the tourniquet should be superseded by the introduction of a more systematic course of instruction in Hygiene and First Aid to the Injured. Without such knowledge on the part of the officers and men, the surgeon and sanitary officer is utterly unable in time of need to cope with the difficulties with which he is suddenly confronted, and the result of this condition of things can only be a repetition of all the disastrous occurrences, a few instances of which have been cited a little while ago and which time and bitter experience ought to have taught us how to avoid. "In times of peace, prepare for war."

The surgeons of the United States Navy, from whom alone this sort of instruction can come, so far as our Navy is concerned, find that they can no longer afford to overlook this part of their duty without some day incurring the just criticism and righteous indignation on the part of their government for culpable neglect of the trust at all times imposed upon them.

The surgeons attached to the different ships and shore-stations alone, however, would be utterly unable to do justice to their duties as they understand them without the commanders of these respective bodies of men having acquired an intelligent

appreciation of this part of their functions by proper instruction so as to aid their surgeons in carrying out their ideas. The men themselves will prove of the greatest assistance to the sanitary officer in his efforts to ward off infectious diseases among them, after having received the necessary instruction in these matters, giving them the reasons why certain things must be done. The work accomplished by our army medical officers is much admired and appreciated wherever it is known and well worthy of our imitation. So long as no one can tell us why the officers and men in the Navy should not receive the practical benefits of modern progress in medicine and surgery, the introduction of the systematic instruction of "First Aid to the Injured" should be encouraged and insisted upon by every officer having the welfare of the service at heart.

The general nature and causation of infectious diseases should be a subject familiar to every officer in the service. The times when typhus, dysentery, cholera, wound-fever, etc., carried off whole armies and paralyzed whole fleets, should never again recur in the future. A battle of Solferino, where the dead and dying lay for days and nights uncared for, and the heartrending description of which by Henry Dunant was the starting-point of the creation of the International Red Cross Association, ought to be sufficient argument for our cause as well.

## The General Nature, Causation and Prevention of Infectious Diseases.

The fact that all infectious diseases are caused by what is called germs or bacteria seems so well established at the present day that there can be no further doubt in the matter. Bacteria produce disease principally in two ways, namely: (1) The germs find their way into the blood either directly, as through a wound, or indirectly, through mucous membranes, and finding all the conditions favorable to their growth and development they begin to multiply so rapidly that they soon become so numerous as to clog up the finer capillaries to such an extent as to render the circulation of the blood through them an utter impossibility. This form of causation is well illustrated in the eruptive fevers, as rose-rash, measles, scarlet fever, small pox, etc., in which the skin eruptions represent the small areas of interrupted capillary circulation. (2) The second method according to which bacteria

produce disease is that, instead of their bodily entering the circulation proper, they remain growing and multiplying at the seat of their primary inoculation, like a fungus on a tree, but produce a poison or toxine which is taken up by the blood-vessels and lymphatics and is thence carried to all the tissues of the body, causing the characteristic disease. This is the case in diphtheria, cholera, typhoid fever, and probably also yellow fever. The simple fact, so familiar to every one of us, and which is that certain individuals are particularly prone to catch a disease and die of it, while certain others do not, although exposed to its influence as much as those who contract the disease and die of it, proves beyond question that there are contained in the tissues and juices of our bodies substances that are able under certain conditions and circumstances to successfully antagonize the invasion of disease-producing micro-organisms.

The experimental study and investigation of the production of immunity against certain disease-producing micro-organisms form at present the most prominent of all the problems of biological research. A knowledge of the principles underlying these investigations is of such fundamental importance from so many points of view, and so well calculated to give you at once a comprehensive idea of the whole drift of modern medicine, that I have been tempted to give you at least an outline of one of these researches. The aim and object of them all is to finally teach us how and in what manner artificial immunity may be conferred upon any or all of us against any or all of the so-called infectious diseases.

The first question that arises is: What constitutes immunity against a disease, the cause of which, it has been proven beyond the question of a doubt, is a micro-organism? An animal is only, then, to be pronounced immune against a certain infectious disease when the particular disease-producing micro-organism is found to be incapable of undergoing multiplication in that animal's blood and other tissues or fluids.

About a year ago, the important discovery was made in Koch's laboratory at Berlin, by a young Japanese physician, Kitasato by name, that the blood-serum of certain animals, when added to fluids in which bacteria were cultivated, had an influence most decidedly antagonistic to their normal growth and development. In some cases it directly impaired their growth and multiplication; in others it would convert the previously poisonous germs into

harmless ones, though not preventing their actual growth. A large number of experiments were at once instituted in Germany, England, France and this country with regard to this point, resulting in the complete confirmation of the experiments of Kitasato. Thus it was found, in the course of these experiments, that it was more especially the blood-serum obtained from those of the animals which had proved themselves naturally immune from certain forms of infectious diseases, when injected into the blood of susceptible animals, would protect them against the disease.

There are substances floating in our bodies that are so extremely fine, so astonishingly subtle as to evade discovery even by the most refined methods of physiological research. The cleverest physiological chemist is as unsuccessful with the very finest of his reagents in catching and separating these finer elements of tissue-metamorphosis as the medical student would be over his dissecting table were he to endeavor to find, scalpel in hand, in the dead body in front of him the spirit of the departed.

It is and will ever remain the immortal merit of Dr. Robert Koch to have advanced and improved our modern methods of biological research, and all our advanced knowledge of disease in modern days is directly traceable to his work. In a recent number of Koch's journal (Zeitschrift fuer Hyg. und Infections-Krankheiten, Band XII, Heft II; Brieger, Kitasato und Wassermann) a most interesting and highly important set of experiments appeared in regard to a substance found in the bodies of all mammals and other vertebrate animals, having also exhibited to a most remarkable degree properties which are antagonistic to the growth and development of disease-producing micro-organisms. This substance is the thymus gland. It had long been suspected that this gland had some important function to perform with regard to the destruction of some of the products of waste, for, in cases of disease of this gland—in other words, whenever from any cause its normal functional integrity was impaired, a disease known as acro-megaly was produced, which is characterized by an abnormal accumulation in the subcutaneous cellular tissue of a substance called "mucin." This substance, a product of destructive tissue-metamorphosis, not being disposed of, accumulates in the system and thus produces this most characteristic disease. The particular bacterium to the growth of which the substance of the thymus gland has been found to be antagonistic

is the bacillus of tetanus (see fig. 1), a disease perhaps better known under the name of lock-jaw.

FIG. 1.—Represents the bacillus of tetanus, from a micro-photograph.

In going over the salient points of these experiments with you, the subject will become clear to you and at the same time will place you in the possession of a key by means of which you will be able to comprehend all the most important problems connected with the entire field of bacteriology and infectious diseases, as they will appear to you in your future readings from time to time.

In the first place you must know that tetanus or lock-jaw is a disease produced by a microbe which affects certain portions of the nervous system and is attended with convulsions that are almost invariably followed by death. The bacillus of tetanus is perhaps one of the best known of all the bacteria, because rather large and most characteristic; its morphology and physiology have been the object of study for many years past; the bacillus, so called because shaped like a rod, is often found in garden-earth somewhat below the surface; one of the ways of obtaining it, indeed, is to take some garden-earth and bury it underneath the skin of a mouse, sewing up the incision over it; the next morning the mouse will be found either dead or suffering from the effects of the disease; its liver, spleen, kidneys and heart-blood will be found to contain almost pure cultures of these tetanus bacilli. It is now easy to collect them, transplant them under proper precautions to their favorite culture-media and raise a large crop of them.

They flourish best when the inoculated test-tubes are kept in a culture-oven at a certain temperature. At the end of the first 24 hours' cultivation the culture is already so poisonous that a single drop of it would suffice to kill any animal living within from 20 to 24 hours.

Now the discovery has lately been made in the Berlin laboratory that, when some of these tetanus cultures were mixed with an infusion made from the thymus gland, the bacilli would grow and multiply the same as in normal culture-fluids, but fail to produce spores; in other words, the addition of thymus-infusion to these tetanus-cultures very materially interfered with their normal development and hence was antagonistic to that extent. The spores, it must be remembered, are the most dangerous parts of the bacilli. When, however, these sporeless bacilli were retransplanted on to more favorable soil, such as, for instance, grape-sugar-agar, the usual spores were again developed in the interior of these bacilli. Thymus-infusion, then, prevented the development of spores without entirely destroying their power of reproducing them.

With a mixture of thymus-infusion and a culture of tetanus-bacilli, the following experiments were now made on mice:

On October 6th, 1891:

| | | | | | |
|---|---|---|---|---|---|
| Mouse | 1 | received | 0.001 | ccm. | subcutaneously, |
| " | 2 | " | 0.01 | " | " |
| " | 3 | " | 0.1 | " | " |
| " | 4 | " | 0.2 | " | " |
| " | 5 | " | 0.5 | " | " |

Six rabbits were now taken and treated similarly; each rabbit received on alternate days gradually increasing doses of this attenuated thymus-tetanus-culture until each one bore a dose of 10 ccm. All these rabbits remained perfectly well, so did the mice.

Three of the above six rabbits were now taken and given each a deadly dose of an original and unmixed tetanus-culture subcutaneously; three fresh and unprepared rabbits received the same dose at the same time. The three last rabbits died within 24 hours; the three former ones remained perfectly well and showed absolutely no sign of disease.

It was now clear that those of the rabbits which had received the attenuated thymus-tetanus-culture had been rendered arti-

ficially immune against the disease, because on them full virulent tetanus-cultures produced no effect, while on rabbits not so prepared they had retained their deadly power.

Blood-serum of animals not susceptible to the disease having been previously shown to produce antagonistic properties when injected into the blood of susceptible animals, three of these protected animals were now bled, and from their blood the serum was prepared in the usual way. With this blood-serum four mice were treated as follows:

Mouse 1 received 0.5 ccm.
" 2 " 0.3 "
" 3 " 0.1 "
" 4 " 0.05 "

these quantities being injected directly into the peritoneal cavity. All four of these mice were well and alive 24 hours later, when each of them was given a deadly dose of full virulent culture of tetanus-bacilli and four fresh mice received the same deadly dose. The four fresh mice were all dead at the end of the next 24 hours; the four which had received the blood-serum from the protected animals remained perfectly well and were well 20 days after.

With this method Brieger, Kitasato and Wassermann were able to save 100 per cent of the animals; less favorable results were obtained with regard to cholera, diphtheria, typhoid and erysipelas.

## Germs and their Relation to Wounds.

The great improvements which have taken place during the last fifteen years in the surgical treatment of wounds, having had their beginnings with the study and discovery of the life-histories and properties of germs or bacteria, I must use the remaining few minutes to make you still better acquainted with them. The three test-tubes which I now pass around contain cultures of three different kinds of bacteria on the ordinary beef-peptone-gelatine (see fig. 2); they were sent to me through the kindness of Dr. Philip S. Wales, of the Museum of Hygiene, and answer the purpose as well as any other to show you how we cultivate them in our laboratories.

Having proved themselves more deadly than guns and ammunition, the rôle which these germs play is of immense importance, and, unless I succeed right in the beginning to impress your minds with this fact, all the aid which you may hereafter be in a

FIG. 2.—Shows how bacteria are cultivated in test-tubes.

position to apply to any one must, necessarily, be of questionable value, faulty, or prove even hurtful and dangerous.

What, then, are these germs? Germs are the most minute microscopic, vegetable organisms in existence, infinitely smaller than the most minute particles of dust, and, unlike dust-particles, which are dead, they are living things, capable of almost indefinite multiplication in a comparatively short space of time. Multiplying as rapidly as they do, they consume a large quantity of food, and, on the other hand, throw out a great deal of new material. They lead the life of tramps, as it were; that is to say, they prefer to live on other creatures. The life-blood of animals seems to possess special attractions for them. A living animal, inoculated with certain kinds of these germs, may die within 24 hours. The germs, by their rapid multiplication, quickly consume the best and life's most sustaining constituents of the body, and leave in their places a changed fluid which proves poisonous to the animal organism, and consequently death follows in their track whenever they find entrance into the living organism, as, for instance, through a wound.

But, fortunately for us, a great many different kinds of these germs are perfectly harmless, some even useful; these, of course, having nothing to do with the causation of disease, do not interest us here. Nevertheless, it is well for you to know that germs are found most everywhere. They exist in the air we breathe, they are present in the water we drink, the soil we live upon and the food we eat; they infest our mouths, our noses, our bowels, and we carry them on our clothes. They are pretty well scattered all over the world, no portion of the globe being without them; they are found on mid-ocean as well as on the highest mountains. Of course, you will perhaps quite understand from this that most of them are, as was mentioned before, perfectly harmless. We breathe them in and out, we drink them in the water and we eat them with our food by the millions every day and no harm results. Indeed, they have been classified according to their properties into three great divisions: (1) those which produce contagious or infectious diseases, as for instance measles, scarlet fever, diphtheria, typhoid and typhus fevers, pneumonia, consumption, hydrophobia, small pox, chancroids, gonorrhœa, etc.; (2) the harmless ones; and (3) those which cause fermentation and decay.

All three kinds of bacteria, however, may produce death in more or less all animals, including mankind, when they accidentally

find entrance into the circulation direct, that is, through a wound. In other words, the same germs which, when swallowed with our food, remain perfectly harmless, when allowed to get into an open wound may cause death by blood-poisoning.

You will now, perhaps, more thoroughly realize and appreciate the fact than you did before, that it is owing to the invention and perfection of certain means and methods by which we manage to prevent the entrance of these germs into the wounds, that the great advances in modern surgical treatment have taken place, and to make you practically acquainted with some of these methods will be the object of the practical part of this first lesson.

Before, however, proceeding to the practical part of this lesson, allow me to call your attention right here at the beginning to something that you must not do under any circumstances. Every surgeon of experience has often had reasons to regret that the knowledge of the most simple little devices used in First Aid is an accomplishment so rarely met with among the people at large. Consequently many people lose their lives, not so much from the serious character of the injuries which they receive as from the fact that First Aid has been ignorantly and unintelligently applied. For instance, you may meet with a severe accident at any time and most anywhere in one of our crowded cities, on board ship, or in the field. Supposing it to be a fracture of the thigh-bone. You are unable to rise to your feet, you look pale, feel extremely weak and finally become unconscious. The people around you will almost instinctively try to do for you whatever in their opinion is the best thing to be done under the circumstances. Most likely they will try to stand you up on your feet and drag you to the nearest drug-store or down into the sick-bay, where, a few minutes after having been carried there, you give up the ghost and die. On examination, the fracture was discovered, and during transport the femoral artery was cut by one of the fragments and death was caused by loss of blood. Or, supposing the artery was left uninjured, one of the fragments has pierced the skin and amputation has become necessary when, under more favorable circumstances, you ought to have made a quick recovery with a useful limb.

Thus, as you see, your future usefulness, your health, your very life may, in that short space of time, be decided by the person coming to your aid and the manner after which he applies to you the first aid or help. In this manner many valuable lives have been

lost that might have been saved; limbs have had to be amputated and thrown away which ought to have been and would have been saved under more favorable circumstances. Therefore, you must always keep in mind the one thing you must not do, namely, Harm! Do no harm! Rather do nothing, whenever in doubt, than add insult to injury. Unless you feel sure you can do him some good, keep your hands off the injured man until some one arrives who knows better than you do what is best to be done.

### Practical Exercises.

The materials used here are:

1. The ordinary operating table furnished to the ships of our Navy, covered with a clean white rubber-sheet and in perfect readiness for an aseptic operation.

2. Several buckets of clean water, soap and brushes; also several towels.

3. One tray with instruments under a solution of carbolic acid, strength 3 per cent.

4. One tray with a solution of corrosive sublimate, 1:1000, containing a few pieces of gauze.

5. Needles, cat-gut ligatures, safety pins, all in antiseptic solutions; iodoform-gauze and bandages for dressings.

6. Tray with alcohol.

7. Irrigator.

We will now suppose that an operation is to be performed requiring absolute surgical cleanliness. The walls, the floor and the ceiling of the room are supposed to have been thoroughly scrubbed and disinfected. Any dust in the atmosphere was removed by sending a spray of turpentine into it; the patient is now brought in, having previously received a bath and been provided with clean clothing; assistants and surgeon the same.

Having taken off his coat and put on a clean apron, the surgeon now begins to prepare his hands and forearms for the operation. He begins by cleaning his finger-nails, which are supposed to be the greatest harbingers of germs and are said to have been the cause of many premature deaths; the surgeon now rolls up his sleeves to the elbow and washes his hands and forearms with soap and water, using a brush in this manner, at the same time explaining as he proceeds that soap, water and the brush only remove ordinary dust and perspiration from the surface of the skin, but by no means are sufficient for the degree of cleanliness required

in an operation. Having done this, the hands must be dipped into alcohol for the purpose of removing the fatty particles adhering to the skin. Lastly, the solution of corrosive sublimate is used to kill any of the germs which still adhere or may fall on the arms and hands during his work. If there should happen to be any delay in the operation, the patient not being quite ready, the surgeon covers his hands with pieces of gauze soaked in the solution until the patient is ready to be operated upon. Every nurse and assistant must, of course, be prepared in the same manner.

The above described method was first devised by Fuerbringer and is the one in general use. Some time ago, however, Professor Wm. H. Welch, of the Johns Hopkins Hospital, proved very conclusively that this method could not be absolutely relied on. He made the important discovery that the skin, like the mouth and the intestines, besides bearing many different forms of bacteria on its surface, has quite a distinct bacterial fauna of its own which infests its very substance. Even after scrubbing the hands as has been described and demonstrated to you just now, Dr. Welch was still able to find living bacteria of a certain kind in the skin. The method of cleaning the hands, as recommended by him, based upon his researches and adopted at the Johns Hopkins Hospital, is as follows:

1. The nails are kept short and clean.

2. The hands are washed thoroughly for several minutes with soap and water, the water being as warm as can be comfortably borne and being frequently changed. A brush sterilized (made germ free) by steam is used. The excess of soap is washed off with water.

3. The hands are immersed from one to two minutes in a warm saturated solution of permanganate of potash and are rubbed over thoroughly with a sterilized swab.

4. They are then placed in a warm saturated solution of oxalic acid, where they remain until complete decolorization of the permanganate occurs.

5. They are then washed off with sterilized salt-solution or water.

6. They may then be immersed for two minutes in sublimate solution 1:500.

Every member of the class is now requested to practice on himself either of the above methods, and the objects of the first lecture, that of giving you an idea of the relation of germs to disease and that of impressing your minds with the importance of cleanliness in the treatment of wounds, will, doubtless, have been attained.

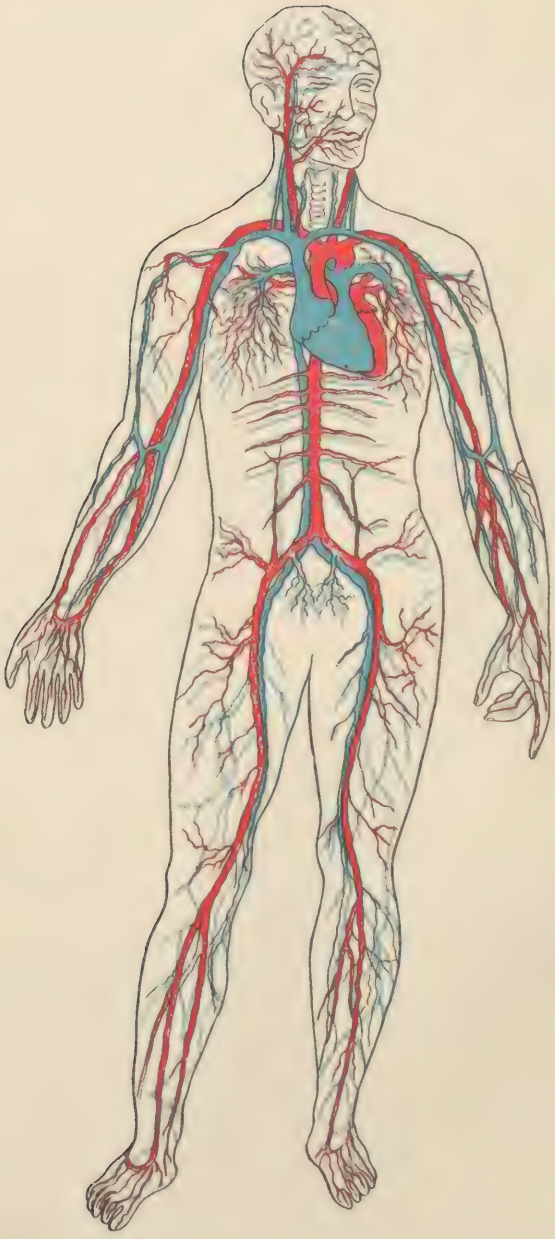


FIG. 4.—Shows the circulation of the blood and the large arteries and veins.


FIG. 3.—The human skeleton.

## LECTURE II.

### ANATOMY AND PHYSIOLOGY.

In to-day's lesson I shall tell you all you need to know about the different parts and organs of the human body, and what their respective functions are which they must perform in order to make life possible and to maintain it.

First, let me call your attention to the three pictures hanging up. One is a representation of a skeleton, that is, of all the solid parts of the body, put together just as they exist in the living subject. (See fig. 3.) The second represents, in a diagrammatic manner, the remaining parts of the human body, which I shall explain more in detail as we go along. The third picture is a very good diagrammatic representation of the circulation. (See fig. 4; also fig. *a*.) We will begin with

*The Bones.*—Without bones the human body would be a shapeless mass of flesh. The skeleton forms the solid basis or groundwork of the body and gives it shape and form. The bones, furthermore, protect the most important organs, such as the brain, spinal cord, heart, lungs and intestine, by throwing a protecting covering or lattice-work around these organs, so that slight injuries, at least, cannot possibly affect them.

*The Head.*—In the head we find twenty bones, most of them very irregular in shape, all very firmly united together with the exception of the lower jaw, which is attached to the base by a joint. The head may be divided into two parts, namely, the *skull*, which is a solid box containing and protecting the brain, and the *face*, in the solid framework of which are set up most of the organs of special sense, like so many precious jewels. The eyes, the ears, the nose and the tongue are all to be found about the face, lodged in very solid, protective recesses. They represent the terminations of the most highly specialized processes of the nervous system, and nature, therefore, has placed them so that they may, with ordinary care and in the ordinary walks of life, escape injury.

*The Spine* consists of twenty-four small, irregular shaped and rather complicated looking bones, placed one on top of another, and which are called vertebrae. These bones, when in position, form a sort of column, called the vertebral column, which forms the main support of the head and trunk. Being firmly held together by very strong bands, the spine can be moved and bent in various directions without displacing any of its component parts.

*The Chest* is formed of twelve ribs on each side, seven of which are called true ribs and five are called false ribs. Behind, these ribs are connected with the spine and are movable; in front they are more firmly united with the breast-bone and are immovable. The chest cavity contains the most important organs of circulation and respiration, namely, the heart and the lungs. Below, this cavity is closed in by a fan-shaped muscle, the diaphragm, which separates the heart and lungs from the stomach and intestine. (See fig. 16.)

*The Basin*, as you see on the diagram (fig. 3), is a very irregular shaped bony ring, giving strong support to the various intestinal organs, and also receiving the lower limbs into two large round sockets, one on each side.

*The Limbs*, in the human subject, are generally spoken of as upper and lower, or arms and legs. Each upper limb is composed of the collar-bone, the shoulder-plate, the upper arm-bone, the two bones of the forearm and the hand, which latter again is divided into the wrist (eight bones), the middle hand (five bones), and the fingers (fourteen bones). Each lower limb consists of the large and powerful thigh-bone, the two bones of the leg, one very much stronger than the other, and the foot, which is composed of twenty-six bones.

*The Joints.* (Figs. 5, 6 and 7.)—All the bones are firmly united to one another by very strong bands of a white fibrous tissue which, in the cases of some joints, completely surround their adjoining ends, thus forming a perfectly air-tight cavity. If you should cut open one of these joints (fig. 5), say the hip-joint, which is one of the most complicated of them all, you would be surprised, on putting your finger on the inside of it, how smooth everything feels. You would also notice a fluid partially filling the cavity of the joint, which is secreted by the lining membrane of the joint and is intended to lubricate it, so as to facilitate motion between the two ends of the bones.

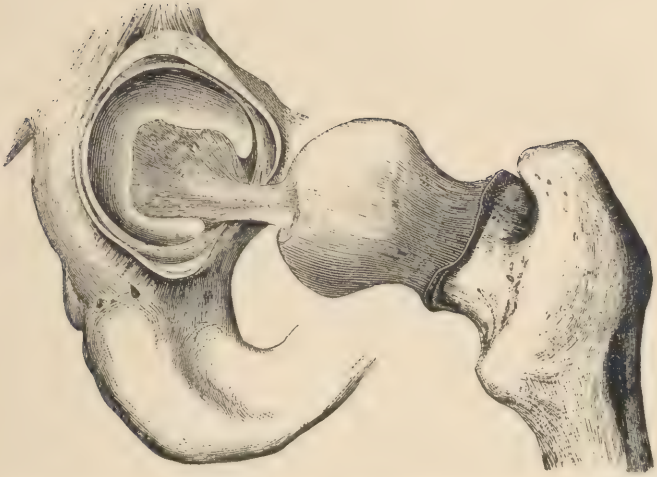


FIG. 5.—Shows the hip-joint laid open ; the head of the femur attached to the acetabulum by the central ligament.

FIG. 6.—Longitudinal section of knee-joint.

FIG. 7.—Finger-joints.

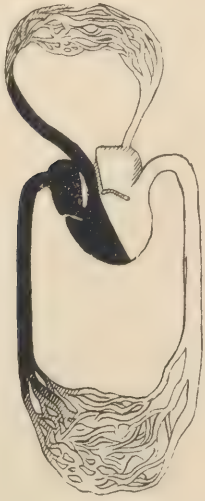


FIG. *a*.

FIG. 11.—Intended to represent the entire cerebro-spinal nervous system.

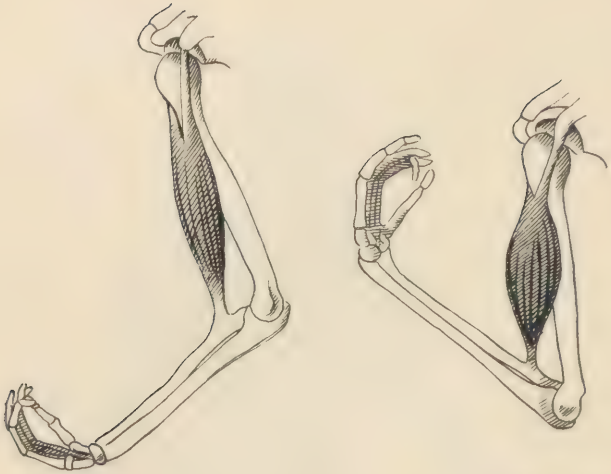


FIG. 9.—Shows the biceps in different stages of contraction.

FIG. 10.—Shows the brain in its relation to the skull and face.

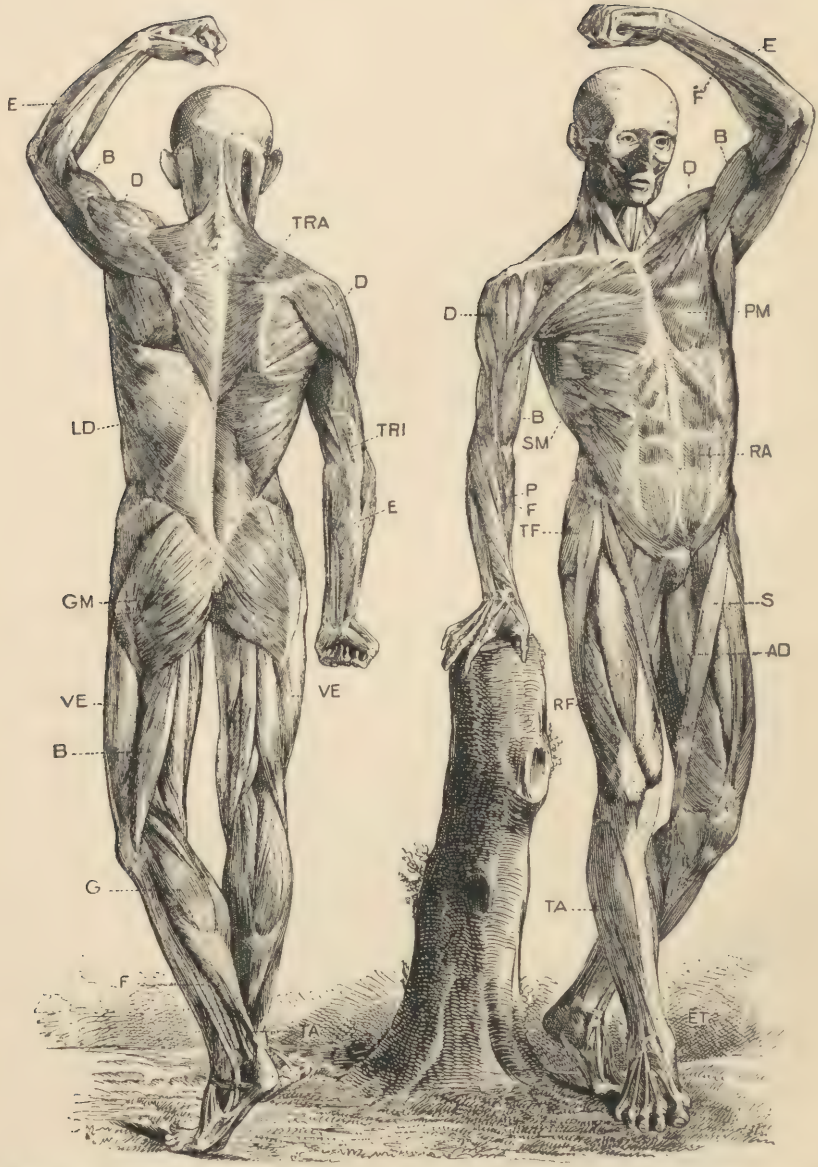



FIG. 8.—Shows most of the skeletal muscles of the human body, with initial letters of their anatomical names.

*The Muscles* (figs. 8 and 9) are the red masses of flesh which are distinguished from other soft parts not only by their color, but more especially by a very remarkable property; they possess, as you all well know, the power of contractility, best illustrated in the long muscles. (Examples, biceps, figure 9.) The sinews in which many of the long muscles end and by means of which they are attached to the bones which they are intended to move, are, on the contrary, not contractile, but rather unyielding. Muscular contractions may be controlled by the will, and then are called voluntary contractions; most of the skeletal muscles are of this kind. They may contract independently from any manifestations of our will power, and those contractions are called involuntary contractions, the muscles themselves being called involuntary muscles. The muscles of most of the viscera, such as the heart, lungs, stomach and intestines, are of this kind.

*The Nervous System*, (see figs. 10 and 11), of all other systems, is the most important, the most wonderful and the most complicated. It is divided into the brain, spinal cord and nerves. The brain presides over all the functions necessary for the maintenance of human life. It is the seat of consciousness; it directs the beating of the heart, the digestion of food; it is through it that we see, hear, smell, taste and feel. Without it, the human mechanism would be a most complicated machine, without a superintending engineer and without motion or sensation. This organ is situated in a very firm, bony case, and is thus protected by nature in accordance with its importance. Injury to the brain means unconsciousness, paralysis of all the muscles of motion, of sensation and speech. The spinal cord is a long, cylindrical cord of nervous tissue contained in the spinal canal, and sending out thirty-one pairs of nerves through small openings in the bones composing the canal. These nerves go to all parts of the body, carrying the various impulses of motion and endowing them with general sensation. Injuries to the spinal cord mean paralysis of motion, and also perhaps sensation, of all the parts below the seat of the injury.

Both brain, spinal cord and nerves are made up of numerous fine fibers and an endless number of cells or pyramidal-shaped minute little bodies. Nerve force is generated in the cells, and the fine fibers which the latter send out in all directions serve the purpose of conductors of whatever energy may be evolved by the particular group of cells with which they happen to be connected. Thus, the spinal cord, which is in direct connection with the brain,

sends into the brain a large number of fibers, and in this way forms really a combination of the brain with all the other organs and tissues, including the skin; just as the queue of a Chinaman is merely the gathered up and braided mass of hair coming from and spreading out all over the hairy scalp, so is the spinal cord only the braided mass of fine nerve fibers coming from the brain and going through the cord into the tissues at large.

*Circulation.*—Before speaking of the circulation, I will first explain the colored diagram which you see before you (figs. 4 and *a*). In the center of the picture you see the heart; the left side is painted a bright scarlet red, and the right side of a blue color. You will also see that all those vessels connected with the left side of the heart are, like that side of the heart itself, of a bright red color, and that all the vessels connected with the right side of the heart also present its color, which is blue.

The red fluid which flows in every variety of organ and tissue in our bodies, and which must flow to keep them alive and functional, is the blood. The blood is kept in constant circulation through a most wonderful piece of apparatus, the heart and a very complicated system of tubes, the arteries, capillaries and veins. The heart (see fig. 12) is a muscular sac, having a number of openings provided with valves. When it contracts, it forces out all its contents in a certain definite direction, owing to the disposition of these valves, and when it expands, it admits a new lot of blood, owing to the same cause. The action of a Davidson syringe (figs. 13 and 14), which you see here, is no mean illustration of this pump action of the heart. But, unlike a Davidson syringe, which has but one cavity, the cavity of the heart is divided into four compartments, two for the right side and two for the left side of the heart. The blood, as you may see on the diagram, is then contained in a closed system of tubes, of which the heart forms the central propelling organ or motor power. We will now follow the blood from the left lower chamber of the heart in its course back to the same compartment. It leaves this chamber by a very large blood-vessel which quickly breaks up into smaller and smaller ones, which finally terminate in such fine little tubes that they can only be seen with the microscope. Those tubes, or vessels, which are thus directly connected with the left side of the heart, leading the blood away from the heart, containing bright red, aerated or purified blood, are the arteries. In these vessels you may feel

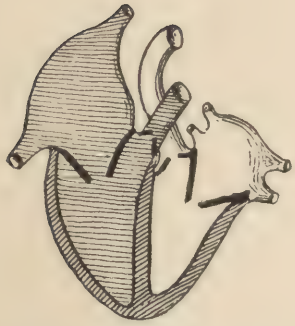


FIG. 12.—Diagrammatic representation of the valves of the heart.

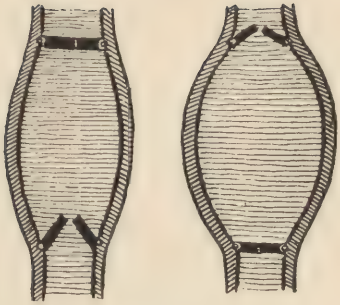


FIG. 13.—Shows valves inside of rubber bulb of a Davidson's syringe.

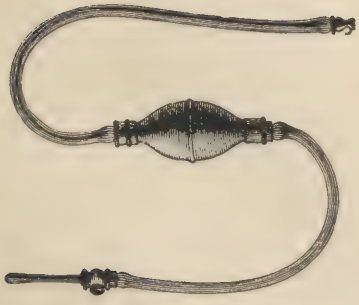


FIG. 14.—Davidson's syringe.

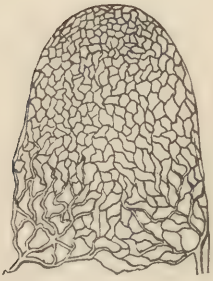


FIG. 15.—Shows an artery breaking up into capillaries on one side and the beginnings of a vein on the other.

the heart's impulse when you place your finger lightly over their course. The very fine, hair-like vessels which these arteries finally terminate in, are called capillaries (fig. 15). Every tissue and organ of our bodies is as completely and thoroughly permeated with these capillaries as are the meshes of a sponge holding water. The slight amount of bleeding noticed in a superficial abrasion is due to the wounding of these minute, microscopical tubes; they reach so very near the surface of our skin that but a few layers of scales separate them from the outer world. (Ex. Pressing on our skin leaves a white mark.) It is here, however, where the blood comes in contact with those tissues which it is intended to nourish and where it performs its most important functions; the largest tubes are merely the channels for conducting the blood to this most important system of capillaries. It is here that the blood gives up its oxygen and receives carbon dioxide in its place. It is here, also, where the bright scarlet color of the blood is changed to a very dark red, almost black color, in consequence of the lost oxygen and the absorption of $CO_2$. From the venous side of the capillaries this blood, which must be refreshened, as it were, is collected again by a different system of vessels, called veins, which now carry this dark, almost black blood back, as you see on the diagram, to the upper chamber of the right heart; hence it is pushed on into the lower or larger chamber of the right heart, from whence it is finally pushed on in a very large blood-vessel into the lungs, where the vessels again break up into capillaries. In these capillaries which penetrate the lungs you will notice that the dark blood is changed again into bright red blood. While in one set of capillaries it lost its oxygen and received carbon dioxide, in the capillaries of the lung the very contrary takes place, namely, the blood loses its carbon dioxide and receives new oxygen. This purified blood is taken up by a few larger vessels and conducted into the upper chamber of the left heart, whence it is propelled on into the lower chamber of the left heart, whence we started in our description. One such turn is called a revolution; the blood makes about two such revolutions in a minute.

From these remarks and by the help of this picture you will have gathered that in a wound filled with bright red blood arteries must have been wounded, and on the other hand, dark blood would indicate that veins were wounded. The former injuries

must be naturally the more serious, as arteries run much deeper than the veins, and more blood is lost through arteries in a given time than through veins, on account of the higher pressure which exists in the arteries.

It was necessary for me to dwell a little more at length on the subject of the circulation of the blood on account of its great importance, which you will be better enabled to appreciate when we come to speak of the application of the tourniquet and other means for arresting bleeding.

*The Lungs* (fig. 16) are two large masses of spongy tissue contained in the chest cavity and serve the purpose of aërating the blood. The air is made to enter the large tube which is easily felt in front of the neck, also called the wind-pipe, and which branches out, tree fashion, into a large number of finer twigs, finally terminating in very small vesicles or expansions. These bladder-like vesicles are completely covered over with a very fine network of blood-vessels, the very capillaries carrying venous blood and wanting to give off their $CO_2$ and receive oxygen in its stead, and which I have been speaking to you about under the head of the circulation. Without this important organ life is impossible. (Example: Tying the trachea of a dog. Mouse under a bell-jar.)

*The Kidneys* (fig. 17) are two large, bean-shaped bodies, situated in the abdominal cavity, in front of and to the side of the spinal column. They are connected with the bladder by the ureters, two large tubes carrying the urine which the kidneys secrete into it. They also are very essential to life, and their diseased condition gives rise to what is called Bright's Disease. Urine, which they secrete, is a solution of a solid substance, urea, and which must, like carbon dioxide, be gotten rid of, otherwise it would poison the blood.

The large sheet of skin (fig. 18) which covers our bodies does not only prevent the soft parts from drying up, but also throws out substances in the perspiration which if retained would poison our blood. The three millions of sweat glands are actively engaged in this work, especially so in hot weather. Nourishment, of course, must supply this constant wear and tear going on within us. We are all familiar with the process of eating and drinking (see figs. 19 and 20). Digestion begins in the mouth, where the food is ground up by the teeth and thoroughly mixed with the alkaline saliva. The resulting paste is passed on through a long muscular tube into the

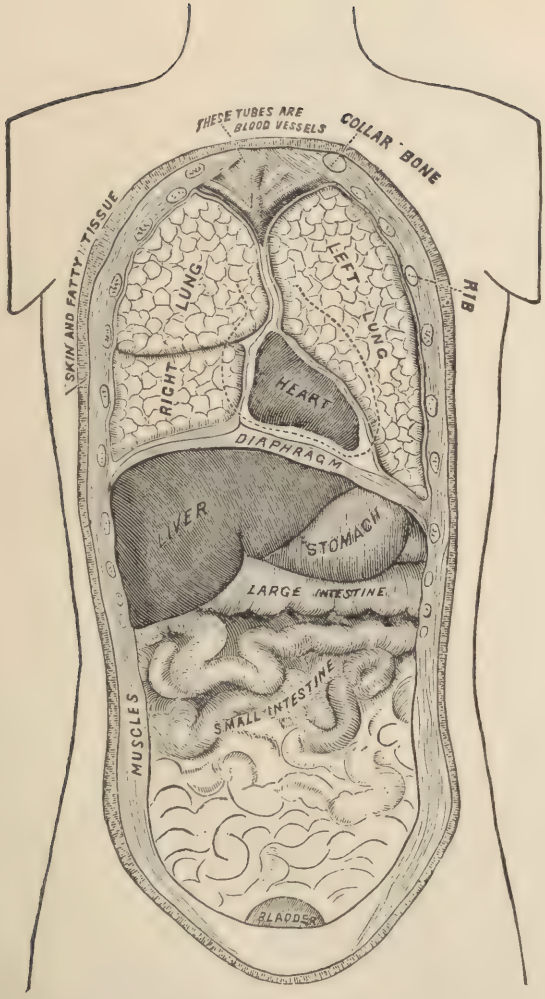



FIG. 16.—Shows all the viscera in position and their relation to one another.

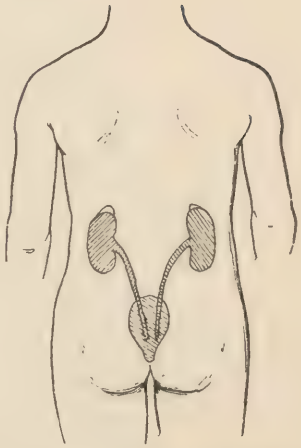


FIG. 17.—Showing kidneys, ureters and bladder.

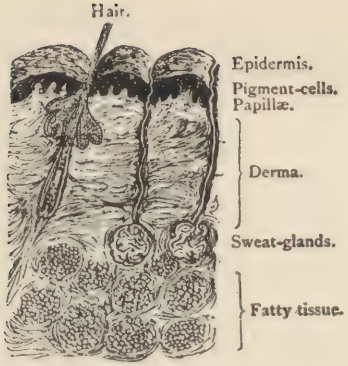



FIG. 18.—Vertical section of skin.

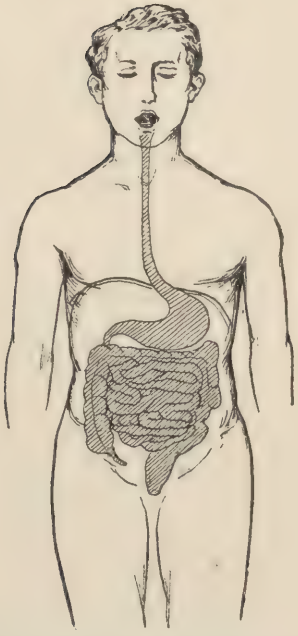


FIG. 19.—Shows stomach-tube, stomach and intestine.

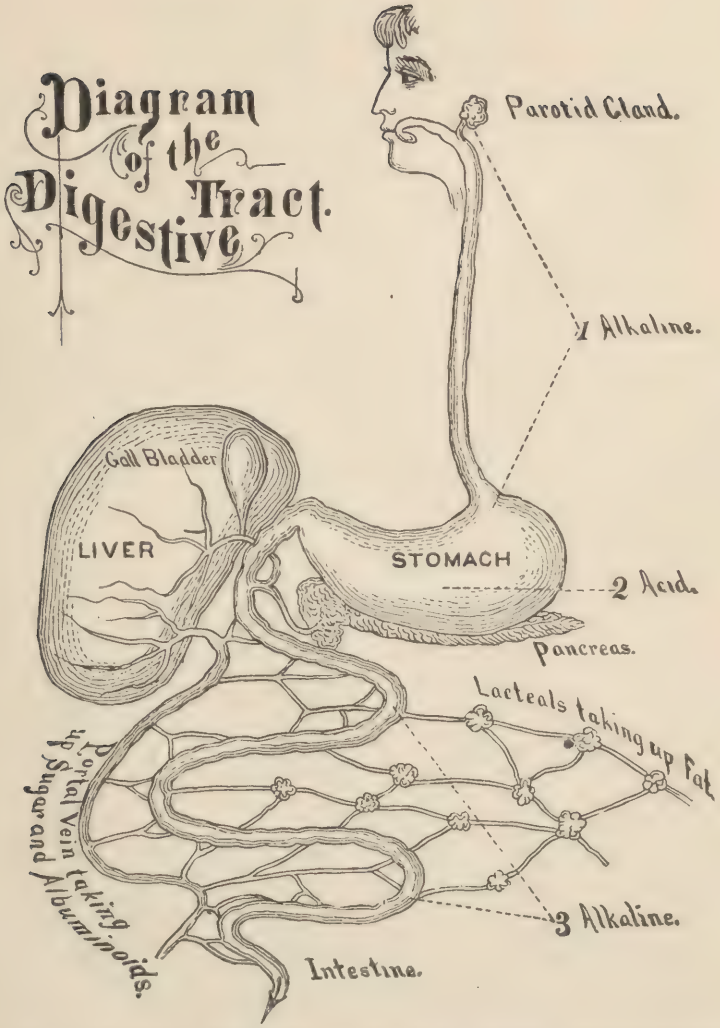



FIG. 20.—Diagram showing the digestion of food and how the food is exposed alternately to the action of alkaline, acid and again alkaline fluids secreted by the different portions of the alimentary canal.

FIG. 21.—Shows results of bad bandaging.

stomach, where the food remains a while, undergoing further acid digestion. From the stomach it passes into the small intestine, where the bile manufactured by the liver helps to prepare it for final absorption and use in the economy at large.

We will now pass on to the practical part of this lesson, which to-day will consist in the application of Esmarch's triangular and quadrangular bandages.

*Bandaging.*—As first-aid-men, allow me to urge upon you the prime necessity for acquiring a thorough knowledge of the art of bandaging. Do not permit yourselves to look upon this part of your work as of minor importance, simply because it has been relegated to what is called "minor surgery." The subject is an important one, and large prizes have been awarded in the past for essays and treatises on bandaging. There is perhaps no one single thing by which one can so well and so readily distinguish a superior nurse from an inferior one as by watching the manner after which he or she puts on a bandage, and if you should ever be so unfortunate as to become a patient yourself, the difference between a good and a bad bandagist would, no doubt, be indelibly engraved upon your mind.

The proper knowledge of bandaging can, very naturally, be acquired only by practice, and what I have to say here on this subject will only relate to some of the more important principles underlying the art of *good* bandaging.

In applying a roller bandage to any part of the body or any of the limbs, you must remember first of all that it should exert an even pressure in every turn throughout its whole length. Secondly, after applying a rather tight dressing or bandage to any part of the arm or leg, a supporting bandage must be put on that part of the limb from the hand or foot respectively up to the place where that dressing or bandage is, otherwise swelling of the part below the dressing will ensue (see fig. 21). The reason for this is simple enough when you recall to your minds your lesson on the circulation of the blood. A tight bandage will compress the veins and in this way impede the return-flow of the blood.

For roller bandages three kinds of material are used, namely: (1) Calicot. (2) Starched gauze bandages, which latter are put into hot water for about a minute before being used, then pressed out and applied. Being somewhat sticky, they are pliable and more apt to stay better than dry ones, and, after drying, form a pretty firm envelope of the part to which they were applied; they

make excellent head-bandages on account of their staying qualities. (3) Muslin bandages are found in all lengths and breadths and can be smoothly applied to all parts of the body. The technique of their application will be shown in the practical exercises that will follow.

Some years ago a so-called "wound-package" was proposed by Prof. v. Esmarch, intended to be carried by every soldier in the field. This package has done great service in the last Franco-German war and also in the wars of the English against the Boors, in Ashantee, Egypt and the Caucasus. This little package contains a triangular bandage, two small pieces of sublimate gauze to be used as compresses, and a gauze bandage four inches broad and six feet long. The whole is well packed and wrapped up in water-proof material, about four inches square and not weighing over three and a half ounces.

In cases of simple gunshot wounds (see fig. 22), one of these gauze compresses is placed over the wounded part after removing the water-proof wrapper. In cases of large wounds, the gauze compresses are unfolded so as to cover the entire exposed surface with them. The bandage (roller) is then applied over the gauze compresses to keep them in place, and the triangular bandage is used for the further protection of the wound, for purposes of support of the wounded member or for tying on splints.

The package may be worn on most any part of the lining of a soldier's or sailor's uniform.

The triangular cloth bandage has become one of the most generally used bandages in first aid. The bandage ought to measure at its base about 60 inches, its height to the tip or point ought to be thirty inches. In its simplest manner it is applied folded together after the manner of a neckerchief. Figs. 23 and 24 show how it is applied to the hand and foot, and fig. 22 shows how it is used over the dressing of a wound. In tying the ends together use the sailor's knot, not the false knot, as shown in figs. 25 and 26. In order to cover the entire hand and foot, the bandage is spread out; the base of it is placed at right angles to the long axis of the part to be covered in, its tip is carried around the part, then the two remaining ends of the bandage are crossed in front of the point, wound around the limb and tied at the most convenient place. See figs. 27 and 28.

When it is to be applied to the head (fig. 29), lay its base across

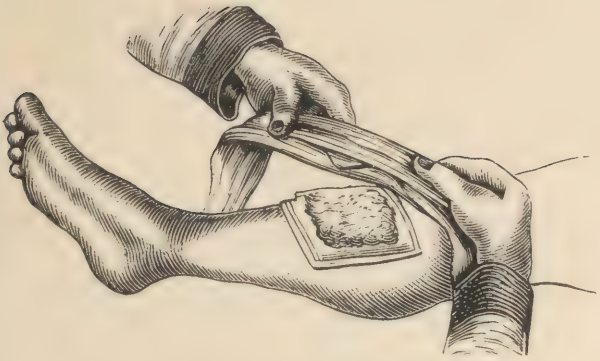


FIG. 22.—Shows how to dress a simple wound.

FIG. 24.—The triangular bandage applied to foot.

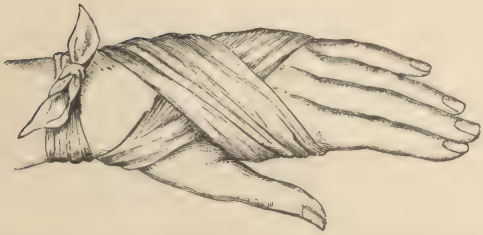


FIG. 23.—The triangular bandage applied to hand.

FIG. 25.—False knot.

FIG. 26.—Sailor's knot.

FIG. 27.—Bandage applied to foot unfolded.

FIG. 29.—Triangular bandage applied to head.

FIG. 28.—Bandage applied to hand unfolded.

FIG. 30.—Triangular bandage applied to chest.

FIG. 32.—Triangular bandage applied to hand, elbow and shoulder, with small arm-sling.

FIG. 33.—Shows different methods of applying triangular bandage.

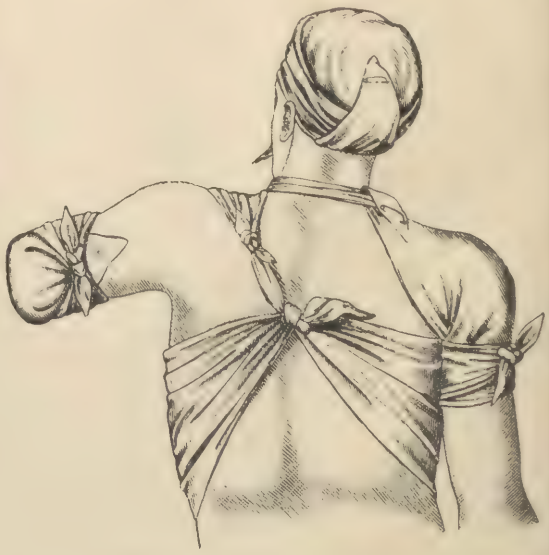


FIG. 31.—Triangular bandage applied to head, shoulder, elbow and chest.

the forehead near the eyebrows, turn the cloth over the top of the head, its point hanging down over the back of the neck; now take the two corners, carry them to the back of the head above the ears, there cross them and bring them back, tying them together over the forehead; lastly, take up the tip end, pull it up over the head and secure it with a safety pin as shown in fig. 29. In this manner wounds on almost any part of the head can be covered.

In wounds about the chest, after proper treatment by disinfection and tying over them the gauze compresses with the roller bandage, the triangular bandage is placed over the chest with the point over one of the shoulders, whichever seems the most convenient, the two ends carried around the chest and there knotted; the point is secured to one of the other ends as represented in figs. 30 and 31.

In wounds of the shoulder, lay the center of the bandage on the top of the arms, with the point up the side of the neck, the lower border lying at right angles to and at about the middle of the arm; carry the two extreme ends around on the inside of the arm, cross them, bring them back on the outside and tie them there. Fold a second bandage and make a small arm-sling of it, then draw the point of the shoulder bandage under the sling, fold it back on itself and fasten with a safety pin on top of the arm. See figs. 31 and 32.

In wounds of the upper arm, place the center of a broad-folded bandage on the front of the limb, carry the ends round to the opposite side, cross them, bring them back and tie them together. Next make a small arm-sling as follows: take a second broad-folded bandage, throw one end over the shoulder on the wounded side, carry it around the neck so as to make it visible on the opposite side, then bind the arm carefully and carry the wrist across the middle of the bandage hanging down in front of the chest; this done, take the lower end over the shoulder on the sound side and knot the two ends together at the nape of the neck. In wounds of the forearm, bandage the wound as in the preceding case, then make a broad arm-sling as follows: take a second bandage, throw one end over the shoulder of the sound side and carry it around the back of the neck, so as to make it appear on the opposite side, where it is to be held fast. Place the point of the bandage behind the elbow of the injured arm and draw down the other end in front of the patient's chest. Next place the arm across the chest over the middle of the cloth, then pick up the

lower end, carry it upwards to the shoulder on the wounded side where it meets the upper end and the two may be tied together; the point may now be drawn forward around the elbow and pinned. Figs. 35, 36 and 37.

The method of applying this bandage to wounds of the thigh, knee, leg and other parts may easily be inferred from the foregoing. See figs. 33, 35, 36, 37.

A very practical and useful bandage, also, is the quadrangular bandage of Esmarch, which, as very well shown in figs. 38 and 39, may be made to be used as a protection for the head and a good part of the neck. In size it is about one meter square. Before applying it, fold it so that the broad margin of one half of the cloth projects about four inches from below the other half; in this way put it over the patient's head so that the middle line of the bandage comes to lie over that of the head, the narrow lateral margins being allowed to fall over the sides of the neck and shoulders. Adjust it so that the lower border of the under layer just covers the tip end of the nose, and that of the upper layer is in line with the eyebrows (fig. 38). Of the four corners now hanging down in front of the neck and upper part of the chest, take the two outer ones and tie them fast to the chin and underneath it; the two inner corners are pulled out, the border covering the nose is folded up over the forehead, and the two corners are carried back over the ears and tied behind (fig. 39).

This bandage, like the triangular one, may also in some special cases be used for making a sling (fig. 34). In rough weather the quadrangular bandage is a most useful one.

In general terms, the triangular and quadrangular bandages may be said to serve the following purposes:

1. As a protection of the parts from dust, heat, cold and insects.

2. To exert a certain pressure over bleeding surfaces, so as to aid in arresting hemorrhage.

3. To keep the injured parts at rest and for the securing of splints.

Another very convenient bandage, easily applied to the head, is the four-tailed bandage (fig. 40). This consists of a piece of muslin thirty inches long by seven wide, slit from both of its ends to within three inches of the center. In order to fix a dressing on the top of the head, lay the center of the bandage over it. Tie the two front ends at the nape of the neck and the two back ends under the

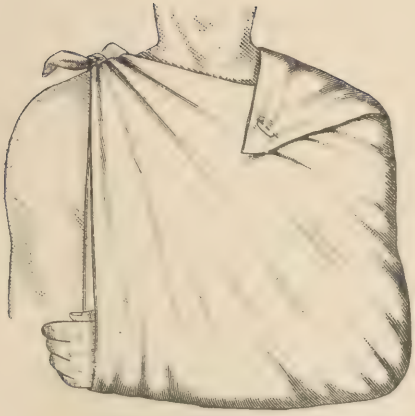


FIG. 34.—Shows quadrangular bandage used as a large arm-sling.

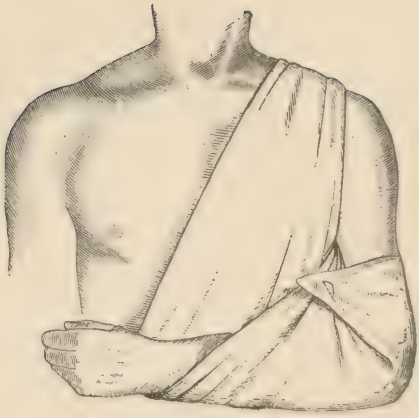


FIG. 35.—Shows different methods of applying triangular bandage.

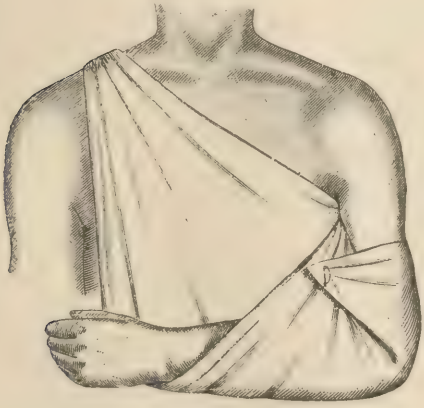


FIG. 36.—Shows different methods of applying triangular bandage.

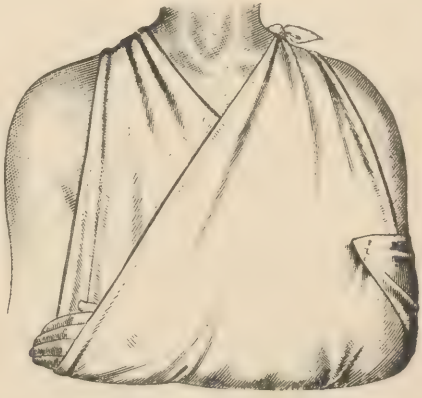


FIG. 37.—Shows different methods of applying triangular bandage.

FIG. 38.—Shows quadrangular bandage folded and placed over the head.

FIG. 39.—Shows quadrangular bandage properly applied.

FIG. 40.—Shows how to apply the four-tailed bandage.

chin. To keep a dressing on the back of the head, tie the front ends under the chin and the back ends over the forehead.

The four-tailed bandage may also be applied to the jaw, but then it only needs a width of three inches. Slit the ends so that four equally long ends are produced, leaving an unslit portion in the center about three inches long. In the center of this portion cut a hole for the chin. Place the chin into this, carry the lower two of the four tails upwards and tie them on top of the head, and finish by tying the upper two tails at the back of the neck. Fig. *b* shows bandage applied to eye.

Practical exercises: Bandaging.

FIG. *b*.

# LECTURE III.

## INJURIES OF THE SOFT PARTS.

The injuries which we are liable to meet with vary much in nature and in gravity. A slight hurt, such as a blow from a man's fist applied to most any part of the body, is hardly ever very dangerous in its consequences and, therefore, needs scarcely any medical attention. An injury inflicted by means of a sharp instrument, resulting in an open wound, though this wound is not very deep, is already a much more serious injury, requiring skilled surgical treatment. If the instrument, which may be a knife, spear, sword or dagger, has penetrated into the cavities of the body in which are contained the heart, lungs, liver, stomach, intestine and bladder, the most serious results may be expected. In such injuries still greater care and skill are required by the attendant than in any of the above-mentioned examples.

The most serious of all injuries, however, are the so-called gunshot injuries produced by missiles that are propelled by some kind of explosive material, and the treatment of which calls for the greatest possible degree of skill and judgment on the part of the surgeon. Gunshot injuries, as a rule, involve both the soft and hard parts of our bodies, giving rise not only to very serious penetrating wounds, but also to fractures and dislocations.

Injuries, as you may see, differ in many ways: they differ in accordance with the particular place to which the external violence causing the injury is applied; they differ with the kind of instrument producing the injury; they differ with the nature of the external violence, and so on.

For our present purpose it will be found both convenient and advantageous if we divide all injuries into two great classes, namely: (1) Those of the *soft* parts and (2) those of the *hard* parts of our bodies. In this lecture we will confine our attention to the consideration of the *injuries* to the soft parts, and likewise divide them for convenience sake into two classes, namely: (1) CONTUSIONS and (2) WOUNDS.

## 1.—Contusions.

The large sheet of skin, covering our bodies, possesses to a high degree the properties of distensibility and elasticity. It is owing to these two properties combined that injuries of the deeper parts are possible without any material injury being at the same time done to the skin itself, and giving rise to what is known as contusions.

Wherever we may be struck by some blunt instrument, the skin, owing to its elasticity, will yield to the pressure, temporarily exerted on it, and so escape injury. It is different with the more delicate tissues which lie beneath the skin, namely, the small arteries, veins and nerves; these are generally ruptured, the arteries and veins pouring their contents into the artificially formed spaces caused by the injury beneath the skin and their neighborhood. If the amount of blood which has escaped is small, then a slight discoloration of the skin will be the only noticeable result of the injury. When, however, the violence producing the injury was considerable and directed to a place where there is a great deal of loose cellular subcutaneous tissue, then the effusion of blood will be correspondingly large and will give rise to what is known as a *blood-boil.* We will then have a more or less distinct and poorly circumscribed swelling, easily yielding to pressure, covered by a much discolored skin, and in which fluctuation may easily be detected, owing to the fact that not all the effused blood undergoes coagulation, some of it remaining fluid.

If the injury occurred to a certain part of the body which is richly supplied with lymph-vessels, the result would be a rupture of these and an effusion of lymph with comparatively little blood. The resulting tumor would be much cleaner looking on account of the lack of discoloration; it would also be much larger and present much greater fluctuation.

Blood, having once left the blood-vessels, does not again return as such into the general circulation; it coagulates after a short while, the coagulum degenerates and the resulting fluid is taken up and absorbed by the lymph-vessels. The length of time which this process occupies, of course, depends on the amount of blood to be absorbed; absorption is, as a rule, very slow, as may be inferred from the time it takes for the discoloration to disappear. The discoloration of the integument, due to the absorption of the

escaped blood pigment, passes from a bluish-brown to a green and light yellow and then disappears without leaving a trace.

The degree of pain felt after a contusion depends on the amount of injury done to the nerve-twigs of that neighborhood.

*Sprains*, so called, present a similar condition of things, although not commonly classed under the head of contusions and most generally understood as injuries involving joints. Nevertheless we find that sprains, like contusions, are accompanied by swelling and pain, owing to the effusion of blood or lymph and the rupture of the finer nerve-twigs at the seat of the injury. The ligaments about the joint may be overstretched or torn completely across, owing to the forcible separation of the bones forming the joint incident to the injury received. The amount of swelling accompanying such an injury to a joint is usually very great, the skin glistens and feels hot, the usual bony prominences have disappeared, and the pain is very severe and on the increase. To the touch, the swelling conveys the impression of a soft, jelly-like mass situated beneath the skin, consisting, as it does, of a coagulum of blood and lymph mixed together.

On account of the local disturbance in the circulation, consequent upon the rupture of blood- and lymph-vessels, collateral circulation and increased transudation of blood-serum through the distended and partly paralysed coats of the blood-vessels must take place, which still further increases the affected swollen and oedematous area. Local inflammation and slight general fever will be found not infrequently complicating such cases.

The treatment of the injuries described so far must differ in accordance with the length of time that was allowed to elapse from the moment the injury occurred to the time when the first help was administered. In case several hours have elapsed and the pain and swelling greatly increased, all that you can do is to place the limb at rest, slightly elevating it and making cold applications with either water or ice. If, however, you should happen to be on the spot but a short time after the occurrence of the injury, then massage the part without further hesitation. The influence of massage on these injuries is twofold: (1) It allays the pain, although, perhaps, itself somewhat painful in the beginning. (2) It initiates and accelerates the otherwise long and tedious process of the absorption of the effused blood and lymph, in this manner shortening the duration of the healing process and thus

restoring the parts to their usefulness in a much shorter space of time than when left to themselves. Massage consists in a number of peculiar mechanical manipulations of the injured parts, all carried out by the hands and fingers of the attendant, such as rubbing, pressing and beating. In fresh injuries gentle rubbing alone is admissible, and this must always be done in the direction from the periphery towards the center. In order to facilitate the gliding of the hand over the parts and also to prevent injuring the skin, the parts must first be oiled. Let us take, for example, a fresh sprain of the wrist-joint which is fit for massage. You would grasp the fingers of the injured extremity with your left hand and pull them slightly away from the wrist; then, with the right hand, after oiling the back of the hand, wrist and part of the forearm, you would begin by making at first very gentle and slow movements with the flat of your hand or the palmar surfaces of your fingers, and carry them up to about the middle of the forearm of your patient; there you take off your hand and go back to whence you started, and so on. Very soon the severe initial pain will cease and now you will apply a little more pressure; after a little while, turn over your patient's hand and treat the other side in the same manner. In this way you may continue for from 20 to 30 minutes at a time, repeating the process whenever necessary. Remember, however, that both in the beginning and towards the end of the massage the pressure to be applied must be of the gentlest kind.

The object of the massage is to cause a quick return of the effused blood and lymph into the circulation through the lymph-vessels, hence also the necessity of rubbing in the direction of the course of these vessels, that is, from the periphery towards the center. After the massage the injured parts are to be covered with wet compresses and a bandage. Under this treatment a sprained wrist or ankle will get well in a few days, while under the delayed treatment as many weeks may pass by.

There is still another class of injuries, occurring now and then, in which the skin also remains unbroken, but with much more serious injury done to the deeper parts than the mere rupture of blood-vessels and lymphatics, and which we must consider here. The ligaments and capsules of joints, tendons and muscles are frequently torn by certain kinds of direct or indirect violence without the skin being broken; but the most serious complications of

contusions, by far, must be looked for in injuries involving the head, chest and abdomen. In blows upon the head that are not sufficient to either cut the skin or fracture the skull, the brain may receive such a shaking-up as to give rise to a temporary paralysis of the brain-centers, including the vaso-motor-centers. The face of the injured person suddenly becomes very pale, his limbs feel cold and his temperature falls below the normal. There is loss of consciousness and general sensation, the patient lying perfectly motionless on the ground; his eyes are closed, the pupils widely dilated and not reacting to light. Breathing is frequent, feeble and shallow; the pulse frequent, feeble and fluttering, sometimes almost imperceptible. There may be vomiting and involuntary evacuations taking place from the bladder and rectum.

Symptoms of paralysis and convulsive twitchings, however, are not part of the symptoms of mere concussion of the brain. If you should find such symptoms present, about the face or any of the extremities, then the case ceases to be one of concussion of the brain and will prove to be one of more profound injury to the brain, for paralysis is a symptom of compression of the organ; the compressing agent may be either blood or a fragment of the fractured skull.

In concussion of the brain the symptoms that present themselves are not unlike those that occur in an ordinary fainting-fit; in both cases we have to deal with a condition of anaemia of the brain. An uncomplicated case of concussion may last from several minutes to so many days, but is seldom followed by death, and when it is the concussion will always be found, on post-mortem, to be associated with more serious injury, perhaps laceration of the brain-substance.

First Aid in such cases consists in placing your patient in a horizontal position *with the head low!* To raise the body or even the head under such circumstances would mean *harm*, not *aid;* it would retard the return of consciousness directly. Next, you must take off your patient's clothes and cover him up with warm blankets or, better, warm bottles; as soon as consciousness returns, give him some warm tea or a very small quantity of brandy; the head is to be covered with cold compresses, for the reason that, in the reaction which follows the condition of anaemia of the brain and which consists in congestion of the organ, cold is the only remedy that can be safely applied to counteract it or prevent it

from being too violent. In watching the patient closely and carefully you will observe this reaction to occur in the face, the extremities and the whole body; the entire surface becomes gradually warm and red. In case this reaction is unduly delayed you may be called upon to bring it about reflexly by holding some strong-smelling substances under his nose, such as ammonia, or by sprinkling cold water into his face, also giving him a cold enema of vinegar; if, however, on the contrary, the reaction is prompt, then remember that *rest* is what your patient most needs, and you should do all in your power to keep every body and every thing away from him that will interfere with his rest. Rest and fresh air will now do all that remains to be done.

Concussion of the brain is, furthermore, frequently associated with concussion of the spinal cord, as is well shown by the pallor and decreased sensibility of the skin, as well as by its coldness. A case of concussion of the cord, pure and simple, passes off without leaving a trace; any symptoms of paralysis or convulsive movements on the return of consciousness, or any involuntary evacuations from the bowels or bladder, or the presence of areas of lost general sensibility with subjective pains in the parts or paralysis, would indicate injury to the substance of the cord itself by pressure or otherwise. The result of such an injury is always a sad one, and all you can do for it as first-aid-men is to secure for your patient as comfortable as possible a position and perhaps place ice over the spine.

Shock, so called, is the result of a concussion of the *sympathetic nervous system* (fig. 41). A sudden fright, a fall, a blow on the stomach, injuries involving the complete loss of an entire limb, received suddenly, large and extensive burns, may be followed by shock. The patient is usually pulseless, pale, with a changed facial expression, deep blue rings about the eyes, covered with cold perspiration, vomits frequently and complains of great thirst. In some of these cases the diagnosis may be difficult and even impossible. In the more serious cases, those that are complicated with severe injury to the internal organs, the best that can be expected of you is:

1. That you send immediately for a physician.

2. That you loosen all tight clothing or take them off altogether, according to the circumstances of the case.

3. That you place the injured person in a comfortable position, allowing no one to handle it until the physician arrives.

4. That the head be placed low when face looks pale and when fainting; high when face looks red.

5. That you sprinkle cold water into his face when no pulse is perceptible at the wrist.

By so doing you *may* save the patient's life. Do more and you ***may*** be the cause of his death!

## 2.—Wounds.

While in contusions the skin remains entire, in wounds it is divided and thus the deeper tissues of the body are exposed. A wound may be superficial,—in other words, the skin and superficial veins may be the only structures that are injured, in which case it may not be immediately dangerous to life. Or the wound may be deep and the more important deeper structures, such as arteries and nerves, muscles and tendons, may have suffered, in which case life may be endangered from loss of blood. Both deep and superficial wounds, however, equally expose the organism to the danger from infection by micro-organisms, and hence the greatest amount of surgical cleanliness is always called for in the dressing of all wounds, whether they be superficial or deep, great or small.

Just as in the case of a contusion, the gravity of a wound differs in accordance with its location and the consequent amount of injury done to the deeper parts, namely, arteries, nerves, lungs, heart, brain, stomach, intestine, liver, etc. But let us, for the present at least, disregard all such cases in which wounds are complicated by injuries to the vital organs that are contained in the different cavities of the body, and let us, furthermore, suppose for a moment that you are perfectly familiar with the means and methods of arresting hemorrhage, a subject of which you will hear in the last part of this lesson; the question arises: What is the best that *you* can do for this wound until the surgeon comes and assumes charge of it. The answer to this question that I should give would be that if, after hemorrhage is arrested, you have put on such a dressing as will prevent the invasion of the wound by micro-organisms, it is the very best that could be expected from you, and that the service which you have rendered your patient by so doing is of the greatest possible importance to him. The next question then is: What does an antiseptic dressing consist in? Antisepsis means nothing more nor less than

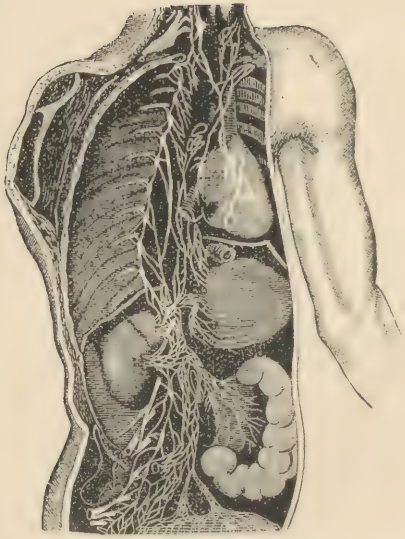


FIG. 41.—Shows the sympathetic system of nerves and their ganglia.

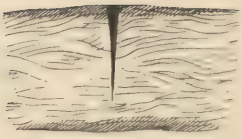


FIG. 42.—Healing by *first intention*.

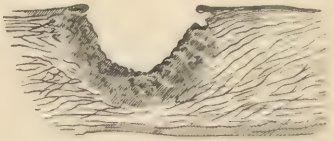


FIG. 43.—Healing by *second intention*.

FIG. 45.—Showing constricting bandage applied to forearm in cases of a poison having been introduced into the hand.

FIG. 44.—Irrigator made from a bottle.

absolute cleanliness. In the first lesson you have learned something with regard to how this is attained so far as your own persons are concerned; the same principles also apply to all wounds, only the practice differs somewhat. To a freshly made wound you would not apply a brush and wash with soap and water, but the surface of the skin around the wound should be treated thus. All clothing in the neighborhood of the wound should be removed; your own hands should be scrupulously clean, the wound should not be touched with anything that is not absolutely clean; anything adhering to the wound, such as clothing, sand, etc., should be carefully removed; the wound itself thoroughly cleansed by irrigation with some antiseptic lotion; a compress of antiseptic cotton and gauze put over it and a clean bandage over the whole. In the practical part of this lesson we will put on such a dressing and make you perfectly familiar with the method of doing so. Of course, the injury which you are called upon to treat may happen to be in a place where antiseptic solutions are not available. Under these circumstances you must let your theoretical conceptions of cleanliness be your guide, use water in abundance and do the best you can and your duty will be done.

Let us next consider wound-healing. How do wounds heal? While every wound calls for some special treatment which must be determined upon by the attendant surgeon, nature, broadly speaking, brings about healing in two ways, namely:

1. Very quickly, through agglutination, without suppuration and with a fine linear cicatrix (fig. 42). It is always and should be the intention of the surgeon to aid nature as much as possible to bring about this rapid form of healing of wounds, which process, however, can only take place under the following favorable conditions, namely: (a) the margins of the wound must be brought into exact contact; (b) bleeding must have been so thoroughly arrested that the margins will not again be separated or pressed apart by secondary hemorrhage; (c) the parts must be kept at absolute rest by properly applied apparatus; (d) the wound must be in a state of asepsis, that is, absolutely clean (fig. 42).

2. The second form of wound-healing takes place slowly, with suppuration and under the formation of proud flesh, finally leaving a broad red scar or cicatrix. This form of healing takes place whenever the above-named favorable conditions are wanting, namely: (1) whenever a good deal of skin was torn away, so

that the wound gapes, or when its margins have been so thoroughly bruised up that they are absolutely dead; (2) when, through bleeding, the margins of the wound are pressed apart; (3) whenever the injured parts are not kept at the requisite rest, through bad transport or insufficient apparatus, which is most likely to happen in times of war; (4) wounds never heal by first intention unless they were in a state of asepsis at the time the sutures were put in (see fig. 43).

Every particle of dirt that was left in the wound sets up local inflammation, which is accompanied by that slow and tedious process known as suppuration. The matter accumulates, presses apart the margins of the wound, proud flesh grows up from the bottom of the wound and a broad cicatrix results. But besides this, the infection of wounds and their subsequent suppuration induce a far more serious condition than the production of a merely unsightly scar; they are accompanied by what is termed wound fever, threatening the very life of the patient. This, however, was the usual way in which wounds were allowed to heal, up to about 20 years ago, when surgeons began to find out the great importance that absolute cleanliness played in the healing process of wounds. In fact it is doubtful that the very significance of the word cleanliness was understood previous to that time, certainly not in its relation to the process of the healing of wounds.

The object of the surgeon is to produce healing according to the first method, if otherwise the circumstances are favorable and will permit it. This process is also called "healing by first intention."

The surgeon endeavors, if possible, to bring the margins or edges of the wound together, keeping them in contact throughout by means of properly adjusted sutures that are supplemented by a supporting bandage. Plasters for the purpose of bringing the margins of wounds together belong to the old method and find no place in modern surgery. All bleeding is arrested by the tying or ligating of all the vessels, arteries and veins with threads of cat-gut properly prepared and previously made aseptic. Cat-gut is used for this purpose because it is absorbed by the system during the period of healing, and hence these ligatures do not require removal.

The wounded part is completely surrounded by a permanent

dressing, affording it not only absolute rest, but also protection from injury and dirt; formerly the dressing was removed daily; now the first dressing remains until the wound has had time to heal, a period varying from 10 to 14 days.

But the most important factor in the quick process of wound-healing is and remains proper attention to surgical cleanliness, as has already been described.

The processes going on in the wound while it is healing are, under normal circumstances, about as follows: The edges of the wound having been carefully adjusted, an effusion of lymph from the divided lymph-vessels takes place; this lymph coagulates and forms a sort of cement which glues the surfaces together. A new formation of blood capillaries and a proliferation of connective tissue corpuscles follows immediately and, in the end, brings about the more organic union of the parts. The whole process is completed within about one week. If, however, it should happen that the two wound-surfaces were not in close contact, the remaining space would be filled with coagulated lymph and blood and would form what is generally called a "dead space." Providing the wound was aseptic, a rapid division and proliferation of connective tissue corpuscles would take place from the walls of this space, new formation of capillaries would quickly follow, accompanied by the immigration of white blood corpuscles which would quickly consume the coagulated mass, and a broad cicatrix be the result. In either case there is no fever nor any other disturbance of the bodily functions, the patient feeling perfectly well. A freshly formed cicatrix is always red, from the large number of newly formed capillaries which it contains; as these disappear in due time the cicatrix assumes the paler color of the surrounding skin and becomes less noticeable. The question is often asked as to whether this or that wound will leave a scar. Whenever the skin is divided in its entirety, a scar will surely be the result; but when the epidermis alone is divided without including its underlying connective tissue cutis, then no scar need be feared.

The second form of wound-healing is, as has been remarked, accompanied with suppuration. Up to about 20 years ago suppuration was believed to be a necessary accompaniment of the healing process. We now know for certain that the process of suppuration in a wound is an abnormal one, produced by the invasion of the wound by a well-defined species of micro-organism;

we can, furthermore, most positively assert that these same micro-organisms are the direct cause of the so-called wound-fever which invariably accompanies this form of healing. In this form of healing the same division and proliferation of connective tissue corpuscles and migration of white blood corpuscles take place as in the other form, but their fabric is interfered with by these micro-organisms, the building material destroyed and discharged and hence lost to the economy. Under proper care healing finally takes place by the formation of granulations from the bottom up and resulting in a broad cicatrix.

Let us now assume we have before us a fresh wound which is covered by a cake of coagulated blood, what are you to do with it? Whenever the dressing to be put on is intended to be merely a temporary protection of the wound from infection until the surgeon arrives, then you may confine your work to cleaning the surface of the wound and the surrounding parts with some antiseptic lotion without interfering with the blood-clot, and cover it with antiseptic gauze and a bandage.

If, on the other hand, more than 12 to 24 hours be most likely to elapse before surgical aid can be secured, then the coagulated blood-clot had better be removed by an irrigator; some iodoform must be dusted over the surface, 8 or 10 layers of gauze, best iodoform gauze, placed over it and folded large enough to slightly overlap the wound; a sheet of India rubber cloth is now placed over the gauze and some absorbent cotton over the latter; the whole is covered by a bandage and the part of the body in which the wound has occurred kept at rest. The India rubber cloth is to prevent the air getting into the wound which might be infected, and also to prevent too rapid drying of the exuded lymph and give rise to an inconvenient scab.

In hospitals so-called irrigators are in constant use; these are simply vessels of either glass or metal and provided with rubber tubes through which the outflow can be regulated. A fine stream of most any antiseptic lotion may in this way be made to flow over any wound for the purpose of cleaning it and disinfecting it. Such an irrigator may be extemporized in a simple manner from any bottle. A bottle is provided with a doubly perforated cork; into one of the holes in the cork a short piece of glass tubing is introduced and into the other a long piece reaching to the bottom of the bottle. The bottle is now filled with the lotion and the cork

with its glass tubes fitted to the bottle. On inverting the bottle a fine stream will flow through the short tube and may be directed anywhere.

The second or air tube may be omitted, if we cut off the bottom of the bottle (fig. 44). This can be accomplished with a stout cord passed around the bottle once or twice at a point at which it is intended to cut, the ends of the cord to be fastened. The bottle is now moved to and fro very quickly until by the friction that point has become very hot, then cold water is poured over it and the bottom will crack off.

Sponges are never used now-a-days in the treatment of wounds. The difficulty in the way of cleaning them thoroughly has determined surgeons to discard them altogether. Absorbent cotton soaked in some antiseptic solution and then pressed out is an excellent substitute for the sponge and is now generally used.

There are sometimes combinations of circumstances that require you to watch your wounds with special care and vigilance, and to which it may be well to call your attention before closing this chapter. Whenever it happens that a wounded person has become unconscious either owing to loss of blood or to shock, all hemorrhage would naturally cease, though large blood-vessels may have been divided and lie gaping at the bottom of the wound. In such cases the hemorrhage would recommence on the return of consciousness, and unless it would find you prepared to meet this emergency your patient would most surely succumb.

The most important disinfectants used in the dressing of wounds and the cleaning of the hands are the following:

| | |
|---|---|
| Carbolic acid | 2–3 per cent. |
| Boracic acid | 2–3 " |
| Thymol | 1 " |
| Benzoic acid | ½–1 " |
| Salicylic acid | 1 " |
| Chloride of zinc | 1–3 " |
| Corros. sublimate | ½–1 per thousand. |

*Poisoned Wounds.* — Sailors, especially men-of-war's men, traveling all over the world and spending a good share of their time in tropical countries in which snakes and other animals are plenty and the bites of which are more or less poisonous, should be somewhat familiar with the methods of treating poisoned wounds.

Whatever is to be done in such cases must be done quickly. Any poison introduced into the system through a wound is taken up either by the veins or the lymph vessels, which, as you will remember, carry their contents, and consequently any foreign substance gotten into them, towards the heart.

Accordingly, your first thought must be of the prevention of this, and you can keep the poison from getting into the circulation by applying a constricting bandage above the wound, that is, between the wound and the heart (fig. 45).

Wounds from poisonous snakes, poisoned arrows, insects or dogs must all be treated alike. After the bandage is secured, rub the limb in the direction from the center towards the periphery, beginning at or near the bandage, thus squeezing out any poison which may have entered the lymphatics; then wash out the wound, burn or cauterize it as much as may seem necessary.

Internally, the administration of whisky with a small amount of ammonia added to it has, according to the most experienced travelers, proved of great service. A large quantity of drinking-water should also be kept ready, for thirst comes on after a time and is very urgent. This thirst had better be satisfied.

*Hemorrhage*.—The prompt and effectual arrest of hemorrhage must be considered the first and foremost duty of the first-aid-man.

Every wound bleeds because in every wound certain blood-vessels have been severed and from their divided ends blood must flow. The character of the hemorrhage varies, very naturally, with the depth and extent of the wound and the kind of vessels which were divided. Thus, for instance, in cases in which blood merely oozes out of the wound, not very copiously at that, we probably will find, on closer examination, that the divided vessels are of the smallest caliber, called capillaries. Whenever blood flows in a constant stream and is of a dark color, it most likely comes from a divided vein (see fig. 46). When, however, the color of the blood is of a bright red or scarlet, spirting out of the wound in an intermittent stream, then you may be sure that one of the arteries has been wounded (see fig. 47).

Hemorrhage from an artery is by far the most dangerous form, the danger increasing in direct proportion to the diameter of the bleeding vessel; the hemorrhage will also be greater when the artery has only been partially divided than it would be had it

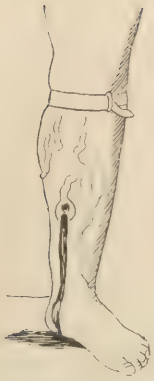


FIG. 46.—Venous hemorrhage.

FIG. 47.—Arterial hemorrhage.

FIG. 48.—Method of making digital central compression over the femoral artery.

FIG. 49 —Digital compression of the carotid.

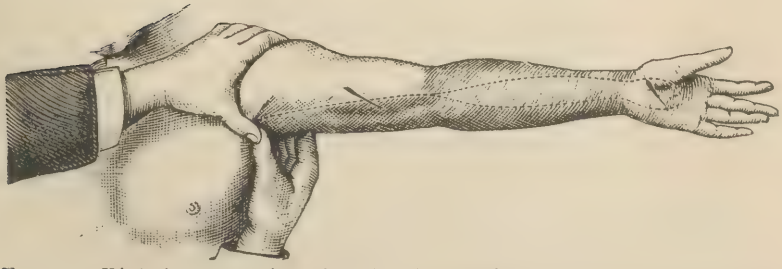


FIG. 50.—Digital compression of the brachial against the head of the humerus.

been completely cut across. Arteries that are completely cut across retract into the tissues and their lumina become much smaller than normally; the internal coat of the artery, besides, curls upon itself and sometimes entirely occludes the vessel. Arteries that are merely wounded cannot save themselves in this way.

The first thing to be done, in cases of arterial hemorrhage, is to compress the bleeding vessel with the fingers either locally, in the wound itself, or at some point of its course outside of the wound. This is called *digital* or *manual* compression. Compression of the artery in the wound, or *local* compression, does not require as much force as compression outside the wound or central compression; for the former method only one hand suffices, its thumb or two of its fingers resting on the vessel; in central compression both hands are generally needed, on account of the great resistance offered by the tissues surrounding the vessel. In order to find the vessel in its course outside the wound you must be sure of your anatomical guides, for pulsation is either very feeble or altogether absent in a bleeding vessel, especially so after considerable loss of blood has taken place.

After having found the vessel, surround the limb with both hands (see fig. 48) and place both thumbs, one on top of the other, over the vessel, using, however, only one thumb at a time for compression; as soon as the one thumb gets tired, compress with the other without changing their former position. It is in this way only that digital compression can be kept up for any length of time, otherwise the strength would fail in both thumbs at the same time and any further compression of the artery become an impossibility. Instead of the thumbs, the finger-tips may also be used advantageously, but then, of course, the surrounding of the limb with the hands is not possible at the same time.

In trying to find and compress an artery in its course it will be well to remember that all large vessels lie on the flexor side of the extremities and that it is always preferable to make compression over the main trunk of the vessel. In hemorrhage about the head and face, it is the large neck-artery, the carotid, which needs to be compressed; in hemorrhage from the arm it is the axillary artery, and in the lower limb it is the large thigh-artery or femoral.

The large arteries in the neck, or carotids, lie on either side, beneath and behind the two long muscular cords that reach from

the top of the sternum to a point behind the ear. For the purpose of compressing these, and in order to avoid compressing the wind-pipe and thus interfering with respiration, both hands must be used, and the finger-tips pushed in underneath these muscles from both their margins and the artery compressed against the spine, as shown in figure 49.

The artery of the upper arm, the brachial, as it is called, runs along the inner margin of the large flexor muscle, the biceps, and may there be compressed against the large arm-bone, or it may be followed up into the axilla and compressed against the head of that bone (see fig. 50); in cases where the great arm artery is cut in the axilla, pressure must be made over the collar-bone and the artery compressed against the first rib, at the same time pulling the shoulder forcibly backwards (see fig. 51).

The main trunk of the artery of the lower limb runs from about the middle of the groin towards the inner side of the knee, and may be compressed in the upper two-thirds of its course against the thigh-bone, as shown in fig. 48.

Besides *digital* or *manual* compression, we have also what is called *instrumental* compression, in which tampons and bandages are used to take the place of fingers and hands. Just as in digital compression, we may here also, according to circumstances, employ either local or central instrumental compression. In local instrumental compression the wound must be packed with antiseptic tampons and surrounded by a bandage (fig. 52); in the extremities, besides making compression over the wound, the parts below must be surrounded with a snugly fitting bandage, especially if the compression at the wound is to be kept up for some time.

In central instrumental compression tourniquets were formerly used, but actual experience in the field as well as in hospitals has demonstrated their uselessness, so that they are now altogether obsolete. In this form of compression the simplest piece of apparatus that is used consists of a plain piece of cloth, handkerchief or neckerchief, which is wound around the limb; a short stick is then pushed underneath it and turned until the bleeding stops. In order to avoid including folds of the skin in the twist a piece of pasteboard or other substance is placed between it and the skin, as shown in fig. 53; another method of compressing the brachial artery may be seen in figures 54 and 55. But the safest and surest

FIG. 51.—Digital compression of the subclavian against the first rib in cases of hemorrhage from the axillary artery.

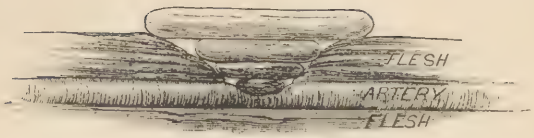



FIG. 52.—Local instrumental compression by tampon made of iodoform gauze.

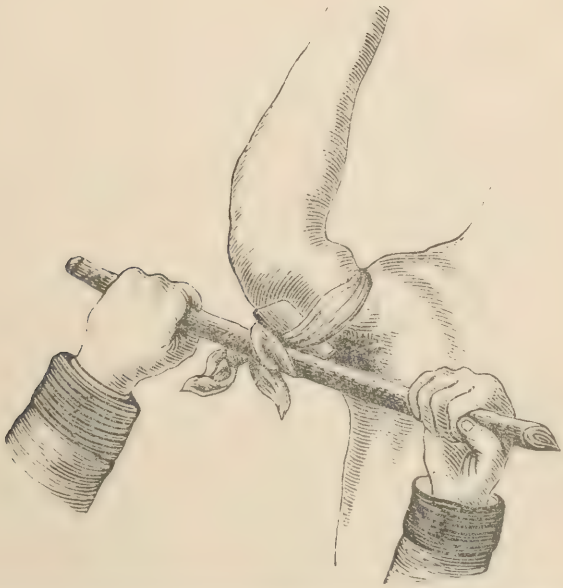


FIG. 53.—Central instrumental compression of the brachial by means of a triangular bandage.

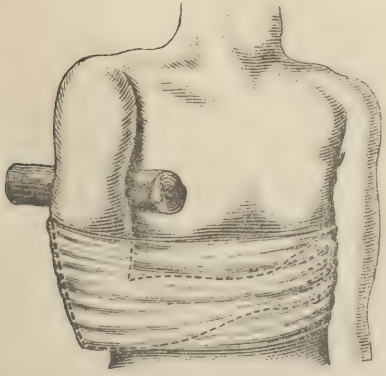


FIG. 54.—Other methods of compression of the brachial artery.

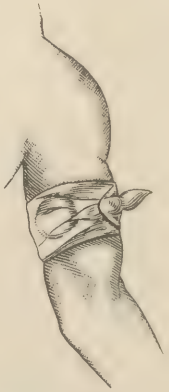


FIG. 55.—Other methods of compression of the brachial artery.

FIG. 56.—Central instrumental compression of the femoral.

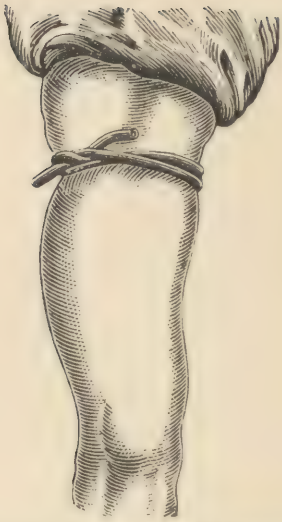


FIG. 57.—Same as 56, by means of a piece of elastic tubing.

FIG. 58.—Shows method of applying elastic bandage for the purpose of compressing the femoral artery.

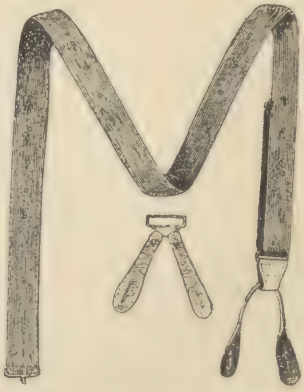


FIG. 59.—The elastic suspender of Esmarch.

FIG. 60.—Auto-transfusion.

method of instrumental compression is that of surrounding the limb with an elastic cord, and it matters not whether this is an elastic bandage, a piece of rubber tubing, or even an elastic suspender (see figures 56, 57, 58 and 59). In all cases of hemorrhage of whatever kind, the vertical suspension or passive elevation of the limb will always be found to prove a great aid in our efforts of accomplishing its arrest.

In this circular method of compression it is quite necessary that it be complete. If this is not the case,—in other words, if blood continues to flow through the main trunk of the vessel into the part of the limb beyond the point where circular compression is being made, it will be noticed that the hemorrhage from the wound suddenly increases on account of the veins above the wound being compressed and the return of blood prevented. The complete arrest of hemorrhage alone proves that your compression is an effectual one, and this must be your aim.

In cases of hemorrhage from the veins, local pressure at the wound by means of an iodoform gauze tampon is mostly always sufficient; in cases requiring circular compression it must, of course, be remembered that the compressing bandage is to be applied peripherally, not centrally.

Capillary hemorrhage is most always arrested by elevation of the limb and constant pressure with an iodoform tampon kept up for five minutes. Iodoform gauze is the best material for these tampons because it possesses both hemostatic as well as antiseptic properties.

So far we have only considered the subject of arresting hemorrhage from the extremities and the neck; we must next in order consider cases of hemorrhage from the different cavities of the body and their treatment.

Hemorrhage from the external ear is rarely, if ever, profuse, arising, as it does in most cases, from a ruptured ear-drum; it is best treated on the principles of a wound, namely, the passage leading to the drum must be thoroughly cleaned out and disinfected and stuffed with antiseptic cotton or gauze. Absolute bodily rest, elevation of the head, with ice over the injured side, will do the remainder.

Bleeding from the nose, when due to an injury, must be treated by absolute rest and the application of ice-bladders to the head and neck. Caution your patient against blowing through

his nose or snuffing up anything. If the hemorrhage does not yield to these means, the nares must be plucked up by the surgeon.

Hemorrhage from the mouth is most easily arrested with either cold water or pressure with the finger made on the bleeding point. In case of bleeding from the sockets of the teeth, which is sometimes very persistent and threatens to become dangerous, the sockets must be tamponed very tightly with bits of iodoform gauze.

Hemorrhage from the lungs, due to external violence, commences with a certain amount of blood being coughed up and expectorated. In such cases all direct methods of arresting the hemorrhage are, of course, out of the question. All the first-aid-man can be expected to do is that he place his man at rest and thus keep him from further harm; the head and body should be elevated, ice-bladders placed over his chest, head and neck, and iced drinks administered internally; keep a little ice in his mouth and also administer some salt dissolved in very cold water. Drugs for the purpose of causing vascular contraction, such as morphine and ergot, must only be given by the advice of the surgeon.

Whenever blood is vomited up, the source of the hemorrhage is most probably in the stomach or stomach-tube, resulting from direct injury of these organs; the nature of the external injury, the place it was received, will, in most cases, greatly assist you in your diagnosis. Such an injury is most always accompanied by a great sense of fullness over the organ, with great sensitiveness on pressure, sweetish taste in the mouth and nausea. The vomited masses consist for the most part in partly fluid, partly coagulated dark masses of blood, never of a bright red color and uniformly mixed with the other fluids, as is the case when the blood is coughed up from the lungs. If the stomach contained particles of food, these will, of course, form part of the vomited mixture. Sometimes it is very difficult, indeed, to exactly locate the source of the hemorrhage coming from the mouth; it may come from the mouth itself, from the nose, the ear, the pharynx, the stomach-tube, the stomach, the larynx, trachea, or the lungs. In such cases the diagnosis can only be made by an experienced physician or surgeon. Fortunately for the first-aid-man, the general care and treatment in all such cases are so much alike that it is of no immediate practical importance whether the exact source of the

hemorrhage is recognized. If, however, the stomach is suspected to be the source of the blood which was vomited up, put your man at rest and administer iced lemonade or alum water internally, making at the same time warm applications to the extremities, cold applications over the stomach.

Hemorrhages into the intestinal canal are not immediately followed by bloody stools, as might be expected, but may be recognized by symptoms indicative of great loss of blood somewhere, leading even to unconsciousness in some very bad cases. The patient suddenly becomes very pale in the face, the lips lose their usual red color, the eye loses its accustomed brilliancy, the whole body and limbs become cold, fainting spells come on, the abdomen begins to swell up and shows great and increasing sensitiveness. Besides absolute bodily rest, the local application of cold and also bandaging the abdomen with elastic bandages may eventually save the patient. Later on, when all danger from death by loss of blood is over, the very characteristic bloody, black, tar-like stools are passed. It may happen that your patient has lost so large an amount of blood before the hemorrhage was successfully checked, that life cannot be sustained on the amount that is left in his vascular system. Feeling for your patient's pulse at the wrist, you may find it either very feeble or altogether absent. Remembering that the heart is a pump and that any pump ceases its work unless supplied with water, so also the heart will stop working unless supplied with blood under a certain pressure, absence of the pulse at the wrist means stoppage of the heart's action, due to a lack of blood in the systemic vessels. One fainting-fit quickly follows upon another, on account of the nerve centers not receiving the necessary amount of nourishment to sustain them in their functions, and death seems unavoidable.

In these cases attempts at revival must be made and kept up patiently and with perseverance and judgment. The first and foremost duty to be fulfilled is to get blood enough into the heart to cause it to resume its action. With this object in view, the blood which is contained in the legs and arms is sent into the blood-vessels of the trunk by their being carefully surrounded throughout with elastic bandages. In this manner these limbs are for the time being excluded from the general circulation, the blood which they contained is squeezed out, as it were, from their vessels and sent into the interior of the body, and the heart, of course,

receiving its share also, will begin to beat again. Inasmuch as this process of elimination of certain members of the body from circulation can only be kept up for a certain limited period of time, only two limbs are excluded at a time, one arm and one leg. After an hour's time these are released and the other corresponding members are taken in hand. This process may be kept up for days without in any way endangering the future usefulness of the members involved, your patient's life thereby saved.

The method usually employed is to take the right arm and suspend vertically and eliminate, say, the right leg from the general circulation by means of an elastic bandage applied to it from the toe up to the groin; after an hour's time, treat the left side in the same way, releasing the right side. In the meantime your patient may be fed on liquid food, such as milk and brandy, beef-tea with the yolk of egg, champagne and other light wines; patients unable or refusing to take nourishment must be fed through the stomach-tube.

The method of temporarily eliminating different parts of the body from the general circulation and infusing their blood into the remaining parts of it, is called *auto-transfusion* (see fig. 60).

Before closing the chapter on hemorrhage I must call your attention to a class of cases, instances of which you will, no doubt, meet with much oftener than you would be inclined to expect, and which present all the chief characteristic signs and symptoms of great loss of blood. Any ordinary fainting fit, little thought of by some and lightly talked about by others, presents, nevertheless, some of these grave symptoms, although not a single blood-vessel is ruptured; such cases simply mean an insufficient amount of blood in the left side of the heart and the systemic arteries, owing either to tight lacing or some other direct interference with the return circulation, or owing to vitiated air, in which case they are brought on reflexly, or both these combined.

Another example illustrating almost exactly the same condition of affairs occurs at times on board ship. Let us suppose a fireman working in a badly ventilated fire-room on a very hot, close day when there is not much air stirring; his body, especially his abdomen, has been exposed for several hours to the influence of great heat from the furnaces of the boilers; he suddenly begins to feel faint, is relieved from duty and struggles up on deck, where he breaks down and lies for a moment almost lifeless. You feel no

pulse at the wrist and your patient looks deathly pale; under these circumstances what are you to do?

Never attempt to raise such a man from the deck, but let him lie undisturbed by any one; keep the head low, loosen all tight clothing, especially around the waist and feet; rub his legs and arms in a direction from the periphery towards the center of the body; make gentle massage movements on his abdomen or, better, surround it entirely with a compress and bandage; as soon as he can swallow give him some brandy and water.

Now, what is the condition of things in his case? If we could look into his chest and abdomen we would find all the numerous veins of the entire intestinal canal, peritoneum and of other viscera contained in the abdominal cavity intensely injected with blood, their coats almost paralyzed; the arteries and the left side of the heart would be found empty, and consequently the heart has ceased to beat. The man is practically dead, and beautifully exemplifies the possibility of one's bleeding to death into one's own veins. No matter, then, where the blood is; as long as there is none in the left heart and the arteries, the man must die. Therefore, all indications for treatment in these cases are the prompt employment of all such means as are calculated getting the blood contained in his over-distended veins back into the heart. You lay him flat on his back to facilitate the flow of blood back to the heart, you make pressure on the abdomen and rub his legs and arms centripetally with the same object in view: you give him brandy internally in order to induce peristaltic or vermicular contractions of the intestinal canal whereby the over-distended veins are freed from the blood which they contain. All these means have the same object, and until this is attained our patient will remain dead; with the equalization of the circulation, however, quick recovery follows.

Practical exercises in dressing and arresting hemorrhage from different parts of the body.

## LECTURE IV.

### FRACTURES.

The force required to break a thoroughly sound bone is generally quite considerable; fractures that are caused by mere muscular contraction, on the other hand, almost always indicate a diseased or abnormal condition of the bony substance. Fractures caused by *direct* violence are almost always associated with severe contusions of the soft parts; there are, however, also instances where the bone against which the violence was directed resists and causes the fracture of a neighboring bone in an *indirect* manner, and in such cases we miss, of course, the usual contused condition of the soft parts complicating cases of *direct* fractures. You will no doubt all remember the case which occurred here not long ago of a cadet breaking his collar-bone by a fall on his side and arm; this was a typical case of fracture caused by indirect violence.

We must also remember that the bones of old people are much more prone to fracture than are those of young people, on account of the greater brittleness which exists in our bones at an advanced age. In children, on the other hand, bones often bend instead of break, that is, the fracture will be found to be incomplete, giving rise to what has been called a *green-stick fracture*, on account of the greater elasticity possessed by the bones at that age. We classify fractures according to different principles. Thus we distinguish them in accordance with the line the fracture takes through a bone, calling them *longitudinal*, *transverse* or *oblique*; we speak of *simple* fractures when the skin remains unbroken (see fig. 61); we speak of *compound* fractures when the skin is divided (see fig. 62); a fracture is called *comminuted* when the bone is broken into fragments, and it is *complicated* whenever there is an injury to a joint or internal viscus associated with it. Gunshot injuries attended by fractures of the bones are, of course, always compound and may, besides, be very much complicated with injuries to the internal organs; it happens occasionally that a

FIG. 61.—Simple fracture of tibia.

FIG. 62.—Compound fracture of tibia.

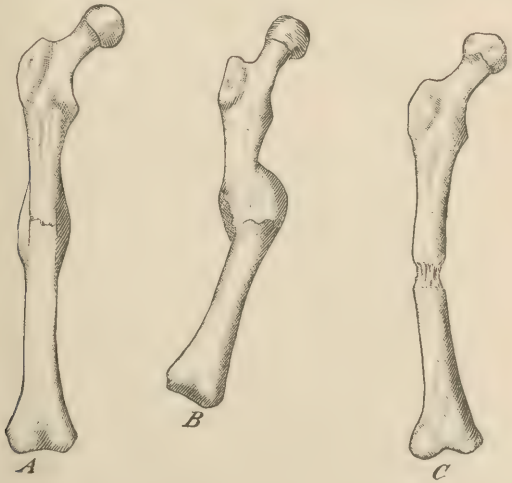



FIG. 63.—Three different forms of healing of long bone.

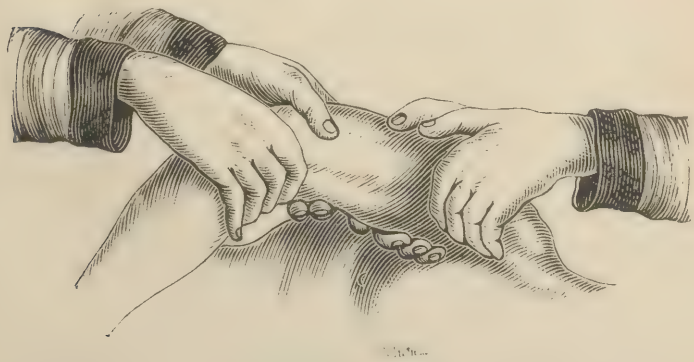


FIG. 64.—Shows method of setting fractures of arm and forearm.

small projectile will perforate a bone without causing it to break in two, or become embedded in its substance without even perforating it completely and lie there for years. Compound fractures are by far the most serious ones because associated with an open wound, and consequently requiring the highest class of surgical skill. The wound may be caused in two ways, namely: (1) the same force which broke the bone may also have cut the skin; (2) the broken ends of the bone may have perforated the skin and other tissues over the fracture.

Any complete fracture of a long bone is most always attended by displacement of the fragments. The kind of displacement, however, that takes place is not always the same. In a fractured knee-cap, for instance, the fragments are pulled apart and a space is left between them. In the fractures that occur in the long bones, on the other hand, the fragments override one another, owing to muscular contraction, whereby a distinct and quite perceptible shortening of the limb is produced. Although this shortening is in most instances due to muscular contraction, it may also be caused directly by the violence that produced the fracture. The least amount of displacement is generally present in fractures of the leg and forearm as long as only one of the two bones is broken.

The quick diagnosis of a fracture is in many cases easy and in others rather difficult, even for the surgeon. Subjective pains and other feelings complained of by the patient, although sometimes of great assistance and greatly helping you in making a diagnosis, must not be allowed to count for more than they are worth.

But even in cases of true fractures, mere pain does not count for much so far as diagnosis is concerned, for that is present in too many other injuries that are not fractures. Your sole reliance in a case of fracture must be placed on your own examination. You would, therefore, begin by inspecting or looking at the injured limb and by trying to discover any change in the shape of it; the tape-measure will tell you of any shortening that may exist when your measurements are compared with those of the corresponding limb of the other side. You may next try to discover any abnormal mobility about the limb and, if you discover such a place at any point of the bone, any attempt on your part to move the two fragments one over the other will be

accompanied by crepitus. Crepitus is a sure sign of fracture, but can only be made out when the fragments are still in contact with one another, that is, when there is not too much displacement. Crepitus, then, although a sure sign of a fracture, must always be looked upon as being dependent on the position of the fragments, and its absence, therefore, would not necessarily exclude the possibility of the existence of a fracture. A change in the form and abnormal mobility of the limb are most always present and therefore constitute the more important signs of fractured bones.

It is only in fractures of the skull in which this abnormal or preternatural mobility does not enter prominently into the diagnostic picture, because there the fragment is generally driven in towards the interior.

Fractures of the base of the skull are attended with the escape of a clear, colorless fluid from the ear on the injured side, and may be diagnosed with certainty in the majority of cases from this alone.

Fractures, then, may be recognized (1) by the abnormal form of the limb and the shortening of the same; (2) by the existence of abnormal mobility at the point; (3) by great pain; (4) by the peculiar grating sound produced when the two ends of the broken bone are moved against each other, as is done in setting the bone.

The normal process of repair in the case of a fractured bone is nothing more nor less than one of cicatrization in its essential elements and, as such, very much like that which takes place in wounds of the soft parts, with the difference, of course, that the process in bones takes a much longer time than in the soft parts, and, also, the resulting cicatrix is a hard, bony one instead of one of connective tissue. At first, a soft cement-like substance oozes out at the broken ends, glueing the properly adjusted fragments together; then a gradual hardening of this cement substance takes place by the deposition in it of lime salts, the mass being now called *callus*. For the complete development of this callus nature requires about four or six weeks. Should it happen that the cement substance remains soft, e. g. that no lime-salts are deposited in it, then the union between the two fragments of bone will be one by connective tissue, and, consequently, preternatural mobility at the seat of fracture will persist. This condition is called a false joint. The accompanying figure 63 shows three forms of repair in bone, namely: (a) normal healing of a well set fracture;

(b) bony union of a badly set fracture, and (c) recovery with a false joint.

The future usefulness of the limb must, of course, greatly depend upon the kind of union which results, and this again must naturally depend on how well the fracture was set in the first place. The proper healing of a fractured bone, in other words, will depend (1) on the health of the individual, (2) on the nature of the fracture, (3) on the setting of the fracture. The most important problems which the first-aid-man must keep in mind are (1) that the two surfaces of the fractured ends be brought into exact contact, and (2) that they remain in this position during the entire process of healing.

While it must be admitted that the proper setting of difficult cases of fracture is the duty of the surgeon and can only be done properly by him, there are, nevertheless, cases that come well within the precinct of the first-aid-man and in which it is his duty to try and do the best he can. The danger of delay in these cases consists in this, that the sharp-pointed ends of the fragments may work their way through the skin or, otherwise, cause so much laceration of the soft parts that they eventually die. This must be more especially considered in fractures of the bones of the foot accompanied with dislocation, and also those of the leg. A prompt adjustment and reduction of all the bones is very necessary in all these cases. In fracture of bones that are uniformly surrounded with thick masses of flesh, this danger is, of course, not so great.

The greatest care and judgment should be exercised in the transporting of these cases. Never raise a man with a broken bone from the ground without at the same time causing to be made the proper extension of the broken limb; this extension, furthermore, should be kept up while his clothes are being cut off.

In order to set a fracture properly, three things are always required, namely, extension, counter-extension, and lateral pressure. Before, however, the reduction is attempted, place your limb in such a position as to cause the relaxation of the muscles attached to either of the fragments, which is best accomplished by a position of passive semiflexion. Extension or traction is best made with the hands; counter-extension can be executed by means of a folded cloth or bandage, the loop of which encircles the limb. Both extension and counter-extension should be made with firm and

steady hands, with force superior to the muscular force to be overcome, and in the way of the reduction.

As soon as the two broken surfaces are brought up to the required point, they must be pressed together, which process requires the use of both hands to surround the limb and should be done with great care. Figs. 64 and 65 show the method of setting a fractured arm and forearm.

A properly set fracture must be supported by an apparatus; this apparatus taking, for the time being, the place of the broken bone, must, consequently, remain in position until the latter has healed and has become solid.

It must be clear that during the whole time it takes to put on this apparatus, extension and counter-extension must be kept up uninterruptedly in order to prevent a re-displacement from taking place before the apparatus is put on.

It is, furthermore, a law in surgery that every apparatus put on for the support of a fractured limb must pass beyond and secure the immobility of the two neighboring joints. An apparatus, for example, for a fractured tibia, must reach beyond the knee and the ankle, and one for the forearm must reach beyond the wrist and the elbow, and so on.

Before thinking of putting up a fractured limb, we must, of course, first make the proper splints. This is, fortunately, not very difficult, and the more familiar you are with the principles of your work and with the ends which you have in view, the more readily will you find the necessary material which will answer your purpose, no matter where the fracture may have occurred at the time. Besides with splints, broken limbs are sometimes surrounded with bandages that are impregnated with certain substances which harden on exposure to the air: plaster of Paris and tripolite (see fig. 66).

But, first aid, in most of the cases at least, will have to confine itself to the putting on of temporary splints. If the accident occurs in a town or village it is, of course, easy to secure all that is necessary in the way of splints and soft material for pads. Rulers, boards, cigar-boxes, razor-strops, broomsticks. pasteboard, felt, walking-canes, umbrellas, parasols may be obtained most anywhere. If the accident occurred in the field, branches from trees, bark, straw, hay stuffed into stockings and trousers' legs, may be made to do as temporary fracture-boxes, as shown in several of

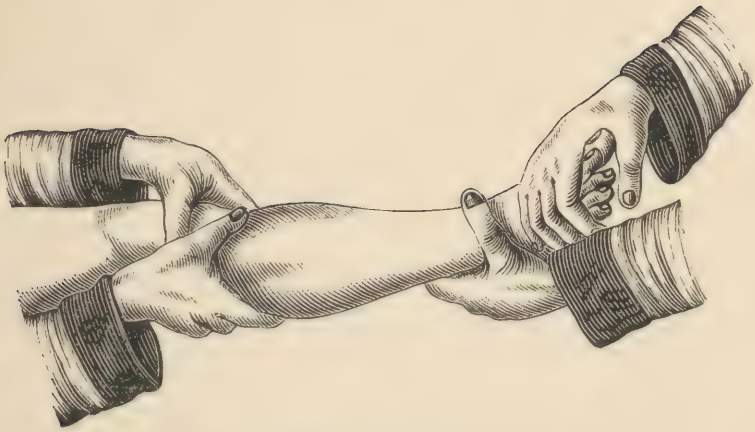


FIG. 65.—Shows method of setting fractures of forearm.

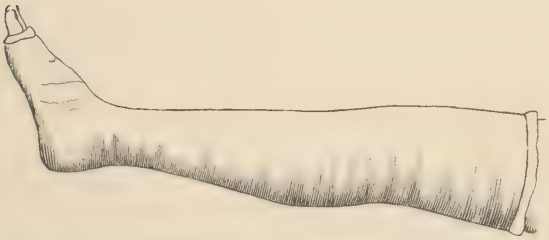


FIG. 66.—Leg and foot done up in Plaster of Paris for fracture.

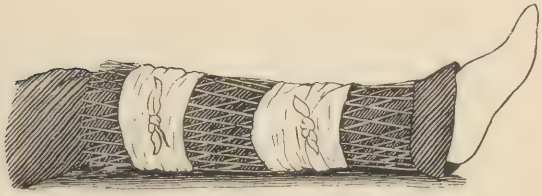


FIG. 67.—Shows various forms of extemporized splints and fracture-boxes.

FIG. 68.—Shows various forms of extemporized splints.

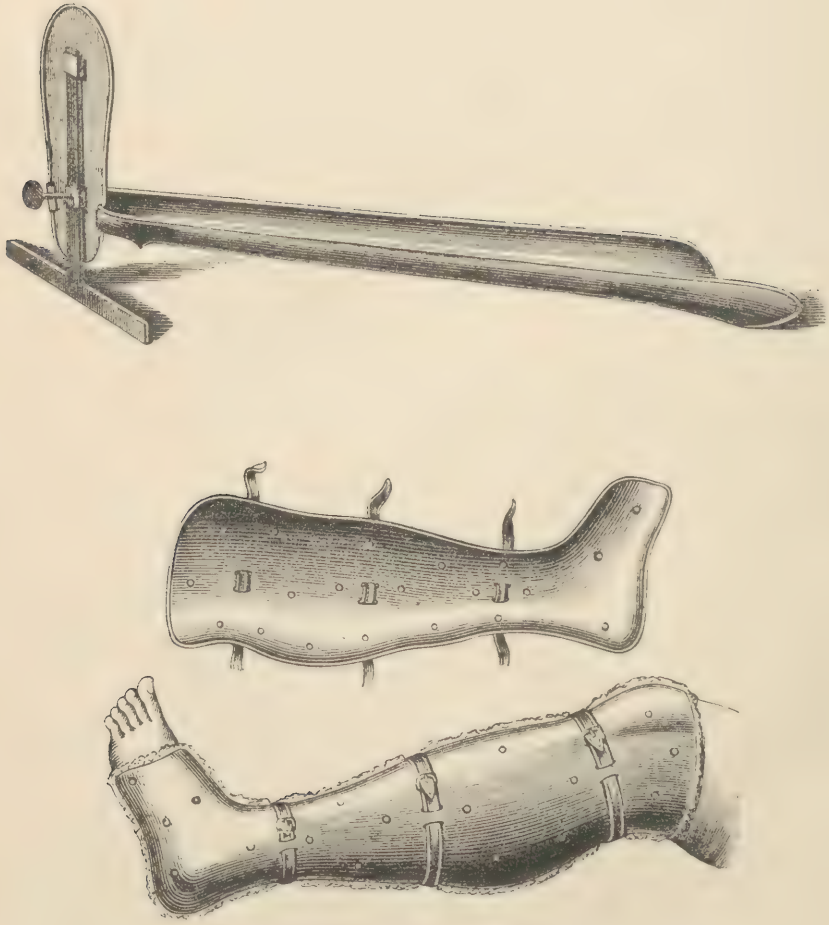
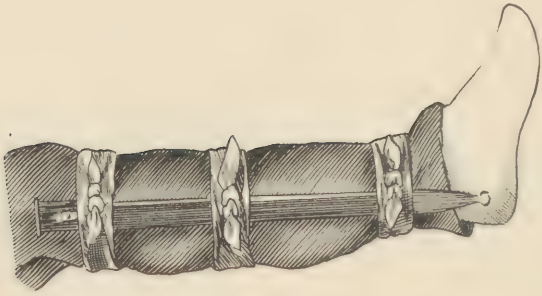
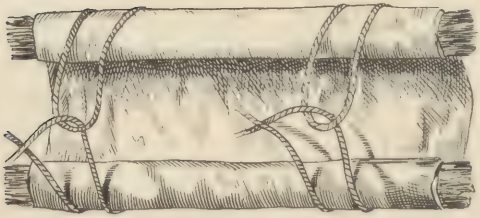


FIG. 72.—Tin splints and leg-rest.

A



B



C

D

FIG. 71.—Shows various forms of extemporized splints and fracture-boxes.

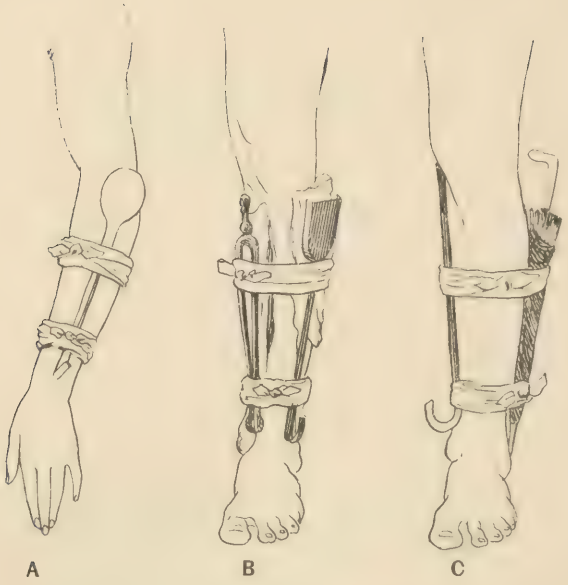



FIG. 69.—Shows various forms of extemporized splints and fracture-boxes.

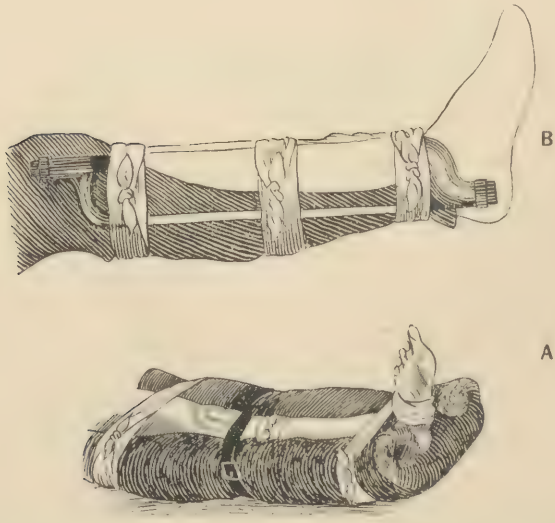



FIG. 70.—Shows various forms of extemporized splints and fracture-boxes.

the accompanying figures. (See 67, 68, 69, 70 and 71.) Most anything will do to fasten the splints on to the limb, shreds of torn clothes, strings of all kinds, suspenders, leather girdles. The accompanying figs. 67--71 show a great variety of extemporized splints as well as fracture-boxes.

Very handy things, especially for fractured legs, are the tin splints which have come into use not very long since, and which are now sold in nearly all the best drug-stores of our large cities. Fig. 72 shows some of these tin boots, made in different sizes to suit all cases and to be purchased at moderate prices.

Whatever form of splints you may use, it will always be necessary to pack them with some soft material such as cotton-wool, in order to prevent pressure on bony prominences, which not only prove very painful after a while, but which also might give rise to very unpleasant sores. Instead of bolstering the splints, cotton-wool bandages are used to surround the limbs before putting on the splints.

The splints must be secured by bandages applied over the outside, care being taken to avoid putting them over the point of fracture on account of the swelling and inflammation which usually develops at these points and the increasing tenderness of these parts.

There is no necessity for that great hurry and urgency required in cases of hemorrhage, and you will have plenty of time to set the fracture well and apply a good safe supporting apparatus before moving your patient. The point of the greatest importance to your patient will always be and remain that you should set the fracture well and, secondly, keep the fragments in position after setting them. The comfort of your patient, e. g. his freedom from pain, being, at the same time, your surest sign that all is well.

*Special Fractures.*—There are three kinds of fractures to which splints are never applied, namely, those of the collar-bone, ribs and skull.

Fractures of the skull are either caused by a fall or a blow, and are almost invariably complicated by unconsciousness and insensibility, on account of a certain amount of injury being done to the brain and its membranes, of which you will hear more in another lesson.

Still more serious than fractures of the vault of the skull are fractures of the *base* of the skull, which latter are caused by a

man's falling with the head upon some soft, yielding substance; the weight of the body in such a case would drive in the base of the skull and fracture it. There is always profound stupor, temporary paralysis of motion and sensation, profuse bleeding from mouth, nose, ears, blood under the conjunctiva, and escape of cerebro-spinal fluid from the ear.

In fractures of the *spine* you have simply paralysis of motion and sensation below the seat of fracture.

In all these cases the best thing you can do is to carefully move the injured person on a litter to some quiet spot with the head slightly raised. Apply ice to the head, and if the arms and legs are cold, warm flannels or sandbags to them. Administer no stimulants!

Fractures of the *ribs* require no splint, as it is impossible to obtain perfect immobility on account of the constant movement which takes place in respiration. This fracture is occasioned by blows or squeezing of the thorax, and is especially liable to be followed by secondary complications, such as inflammation of the lungs or of the pleural membranes, either of which may have been injured at the time of the accident. By placing the hand over the seat of the injury and asking the patient to cough, crepitus is easily felt. A bandage folded broad and passed around the chest is the only first aid that can be rendered in such cases. In those complicated cases in which there is perforation of the lung tissue by the sharp end of a broken rib, known at once by bleeding from the mouth, with the coughing up of blood-stained frothy sputa and the escape of air into the subcutaneous tissue, no bandage or any tight constriction must be allowed around the chest, as the broken end of the rib would thereby be further driven into the lung tissue. Braces should be loosened, stays unfastened and all impediments to free breathing removed.

Fracture of the *lower jaw-bone* may occur from blows or falls upon the chin. The mouth is found to be closed and not widely open as in cases of dislocation. The line of the teeth is irregular, as well as the external outline of the jaw.

This fracture requires two bandages folded very narrow and a splint made out of cardboard to fit the jaw so as to form a sort of cap for it. One bandage is placed below the chin and knotted at the top of the head, whilst the other, placed with its center on the chin, is carried to the back of the head, crossed and then

brought forward round on to the forehead and tied there. The ears are not to be covered over, but left in the center of the triangle formed by the bandages at the side of the head. All four ends of the bandages may be subsequently tied together.

Fracture of the *collar-bone or clavicle* is occasioned by falls on the outstretched hand. The heavy shoulder with the arm attached rolls forward and downward, the patient instinctively supporting his elbow with the opposite hand. A large wedge-shaped pad should be extemporized and put into the arm-pit on the injured side with the broad end of the pad uppermost, and this is kept in position by a bandage passed around the body to prevent movements of the arm on that side. Care should be taken not to pass a bandage over the seat of fracture or make any pressure there, because being painful and liable to displace the fragments. The hand may be supported by a sling.

Fracture of the *upper arm or humerus* occurs from direct blows or falls upon the elbow. Extension should be made and then three splints put on. The splints should reach from the shoulder to the elbow and should be placed one in front, one on the outside and the third on the back of the arm (see fig. 73). The inner splint is omitted so that no undue pressure may result to the blood-vessels lying on that side. The splints should be fastened by two triangular folded bandages and the forearm flexed and supported by a sling, which must be small and not reach up to the elbow. Be careful to put on the arm-sling with the elbow at right angles, and never allow the hand to drop lower than the elbow.

An extended trellis flower pot cover forms an excellent splint for this fracture (see fig. 67) as well as for fractures of the limbs in general; care, however, should be taken that it is well padded so as not to arrest the circulation in the limb.

In case the fracture happens to be at the lower end of the humerus, close to the elbow-joint and perhaps combined with some injury to the bones of the forearm, a rectangular splint should be applied to the inner side of the elbow-joint with the arm in a semiflexed position. Two pieces of wood can be lashed together by a bandage wound around them where the pieces of wood cross one another, and thus a rectangular splint easily constructed. Outside splints must be applied as well.

Fracture of the *forearm or radius and ulna* occurs usually from falls, but may also happen from direct blows. The arm

should be placed in a semiflexed position and two splints put on. The splint on the inner side should extend from the elbow to the tips of the fingers, and the outer one from the elbow to the wrist joint. Two bandages folded narrow keep the splints in position, and the arm is subsequently supported with a large arm-sling.

Fractures of the *fingers or phalanges* are almost always caused by direct violence. They require a long, narrow splint, which should extend from a little above the wrist to the tip of the injured finger, applied to its palmar surface. A long paper-knife answers the purpose admirably. The hand should be subsequently supported by a large or small arm-sling. Another very comfortable plan of treating this injury is to flex the fingers over a cricket-ball and bind them there.

Fractures of the *thigh bone or femur* occur from falls, and in the aged from very trifling causes. It requires two splints: the one on the outer side should be a very long one and extend from the arm-pit to the sole of the foot (see fig. 71), whilst the shorter one should be placed on the inner side of the thigh and should reach from the fork to a little below the knee-joint. Four bandages folded broadly are required. One is applied in the figure of 8 form around the sole of the foot and ankle-joint, taking in at the same time the lower end of the splint, the bandage crossing itself on the instep. A second bandage should be placed below the seat of fracture and just above the knee-joint, and a third above the seat of fracture as close to the hip-joint as possible. The fourth bandage is applied round the abdomen to keep the upper end of the splint in close proximity to the body. Finally bind both legs together, as greater support is thereby given to the injured limb.

A rifle may be used as the outside splint in this injury. The butt end is placed in the arm-pit and the stock down the leg, with the barrel towards the ground on which the man is lying.

Keep in mind that the joints above and below the fracture must be rendered immovable or as much so as that can be done.

Fracture of the *knee-cap or patella* occurs usually from muscular action and occasionally by direct blows. Two bandages, folded narrow, are required; the first is placed with its center below the knee-cap, carried to the back of the joint, crossed behind the splint, and brought above the knee-cap and tied in a knot. (A broad splint should be applied to the back of the knee-joint extending some eight inches above and below it.) The

FIG. 73.—Showing position of splints in case of fracture of arm.

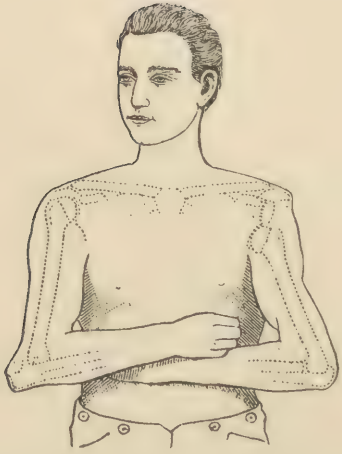


FIG. 74.—Shows dislocation of head of humerus into axilla (left side).

FIG. 75.—Dislocation of lower jaw.

second bandage is put on in a similar figure of 8 manner, but is placed first above the knee-cap, then crossed behind the splint and knotted below the knee-cap. The broken fragments, generally very widely separated, are by this means, assisted by elevation of the limbs, brought close together. The front of the joint is left uncovered, so that cold applications or an ice-bag can be applied to the swelling, which is always considerable.

Fractures of the *leg bones or tibia and fibula* are occasioned usually by direct violence, but sometimes by a sudden twist of the ankle. Two splints are required of the same length, to extend from just above the knee-joint to the sole of the foot. One is placed on the inner and the other on the outer side of the limb and kept in position by two bandages. One is passed in a figure of 8 form around the sole of the foot and ankle-joint; taking in at the same time the two splints, the bandage crosses itself on the instep. The other bandage is applied just below the knee-joint; thus all movement from above and below is prevented.

A scabbard may be used for the outside splint in this injury, or a couple of bayonets, the point of each bayonet fitting into the lock of the other (see figs. 70 and 71).

When the fibula alone is broken, the tibia forms a splint for it and people are able to walk with this fracture. Splints must be applied to this fracture in the same manner as if both bones were broken.

Fractures about the foot are always caused by direct violence. They require a special form of splint, made rectangular, into which the heel fits; the sole of the foot resting against one support and the calf of the leg against the other. The first aid consists in elevating the foot and applying cold water.

The important matter of safely transporting the injured persons will be treated of in a special chapter.

*Dislocation.* See figs. 74 and 75.—Whenever a bone is thrown out of the position it naturally occupies in the body, it is said to be dislocated. A dislocation is always complicated with more or less severe injury to one or more joints; its ligaments may be torn and the joint surfaces injured in various ways. As regards the reduction of a dislocation there is little to be said to the first-aid-man; the sooner you obtain medical assistance the better; for the sooner a dislocated bone is put back into place, the easier that process can be accomplished. The longer a time is allowed to elapse, the

more difficult will be the reduction of the dislocated member, it may even become entirely impossible, and consequently deformity and loss of power will remain for the rest of life. The reason why I should not advise a first-aid-man to attempt the reduction of a dislocation is the great danger with which careless and ignorant procedures of this kind have been attended. Blood-vessels and nerves have been torn across, and the entire limb even has been known to have been dragged off.

*Comparisons between Fractures and Dislocations.* — In both cases there is deformity and pain; but, while in fractures you will find increased and unnatural movement in any part of the limb, in dislocations you have a decrease if not entire loss of movement in connection with the implicated joint.

In a dislocation there may be shortening or lengthening of the limb, according to the position assumed by the displaced bone, but in a fracture there is nearly always a shortening, from the fragments overlapping one another. The more important distinguishing sign is the presence of a grating noise, or crepitus, in the line of the shaft of the bone in cases of fracture, while in dislocations there is an absence of crepitus and the seat of the injury is always a joint.

The distinguishing features of the two classes of injuries are best shown in the following table:

| Fractures. | Dislocations. |
|---|---|
| Deformity and pain. | Deformity and pain. |
| Crepitus. | No crepitus. |
| Unnatural mobility. | Movement limited. |
| Easily replaced. | Replaced with difficulty. |
| Limb shortened. | Limb shortened or lengthened. |
| Seat of injury anywhere in the bone. | Seat of injury at a joint. |

Another and final piece of advice to you is, that, no matter what the injury may be that you are dealing with at the time, always compare the injured limb with the sound one on the opposite side of the body. You will quickly perceive by comparison what you might overlook without it, namely, any irregularity in the shape or deficiency of movement, as well as any change in the respective length of the limb.

*Practical Exercises.*—The practical work done after this lecture consists in the making and applying of splints from all sorts of material to supposed fractures.

## LECTURE V.

### BURNS AND SCALDS.

There are substances which produce injuries by virtue of their chemical composition and by the chemical changes which they arouse in living tissues whenever brought in contact with them. The so-called alkalies and acids are the principal substances of this class, and caustic ammonia, soda and potash constitute the chief ones of the alkalies, while muriatic, nitric and sulphuric acids are the most dangerous representatives of the acid class.

Their effects upon living tissues, however, are so similar to those produced by burns and scalds, injuries caused by fire or steam, etc., that they may well be spoken of under one head.

The eschar which these substances produce arouses local inflammation, followed by suppuration and a slow and very gradual process of repair of the injury by cicatrization through the formation of granulation tissue.

Both acids and alkalies may come in contact either with the skin or with the mucous lining of the mouth, throat and stomach. Whenever alkalies are brought in contact with mucous membranes the eschar which is formed will be of a dirty white color, while acids will produce a brown discoloration in them.

These substances are sometimes swallowed with suicidal intentions, are very dangerous in their consequences, and, when not followed by immediate death, are at least always succeeded by very burdensome strictures of the oesophagus, obliging the poor unfortunate victims to remain permanently under medical care for the remainder of their natural lives.

First aid, in these cases, consists principally in neutralizing these substances, chemically speaking; thus, in case lye was swallowed, you would have to administer vinegar or lemon-juice, and if it was an acid that was swallowed, solutions of alkalies in water or milk must be given, the best of which are magnesia and bicarbonate of soda. Injuries to the skin by these substances must, of course, be treated on the same principles.

In case any one should happen to fall into a lime-kiln, it would be a dangerous proceeding to try and wash off the lime adhering to any part of the body with water unless a very large quantity of it was on hand and complete immersion possible; if this is not the case, oil should be the thing made use of.

*Burns* may be produced by molten metal, overheated liquids or gases. Three degrees of burns are generally distinguished in accordance with the extent of the damage done to the parts affected. Whenever the skin is merely reddened, it is called a burn of the first degree; if the injury leads to the formation of blisters it is called one of the second degree, and if the parts are completely charred the injury is called a burn of the third degree, whether this is superficial or whether this includes the muscles and bones (see fig. 76).

The first two degrees of burns are often found together, sometimes all three degrees are found associated. Burns are dangerous injuries, being often followed by death. Fires in theaters, explosions of gas or powder, benzine or petroleum occur but rarely without some one's clothing catching afire. The victims of such accidents should be promptly warned not to run, which they most generally are inclined to do; the flames are most quickly extinguished by the person being thrown on the ground and rolled about; covering it up with clothing, blankets, rugs or anything that may be at hand which will quickly put out the flames, such as water.

The flames having been extinguished, water in great abundance should be used, the person removed to a warm room and warm stimulating drinks administered. The clothes should be taken off with the greatest possible care; in places where they stick to the skin, the scissors must be used to cut around the adhering portion so as to leave them in place, because, the skin being the best protection, it must under all circumstances be left in place.

Blisters may be pricked with a clean needle and the fluid gently pressed out.

All these injuries soon become exceedingly painful, especially when deprived of the skin and exposed to the air, the effects of which we must endeavor to counteract by the application of oil. The complete immersion of the parts under water, or the external application of flour or raw potatoes is also very soothing.

When, however, you are treating burns of the second degree,

then you must remember that you are treating wounds, and as such all the precautions necessary in the modern treatment of wounds and of which you have heard in the third lecture of this course must be observed.

After preparing everything for an antiseptic dressing, the blisters must be opened with an absolutely clean pair of scissors, the fluid pressed out and the dead epidermis removed. The best antiseptic substance that can be used in the dressing of burns is, without doubt, the iodoform, which may be applied either in the form of the powder or in that of the liniment made as follows: Take equal parts of oil and lime-water and mix the two well together by shaking, then add to this mixture about one per cent of thymol, two per cent of creolin and ten per cent of iodoform.

After completely covering the surface of the wound with the iodoform or the liniment, put several layers of iodoform gauze over the same and a layer of rubber-cloth over the gauze; cover the latter now with a thick layer of cotton-wool and secure the dressing by a bandage. Iodoform acts like magic in these burns; but a short time after its application the excruciating pain that usually accompanies these injuries ceases altogether and the patient may then be transported without any suffering or material inconvenience.

In case the materials necessary for an antiseptic dressing are not at hand you must be content with simply pricking the blisters and squeezing out their contents, leaving on the dead skin as a temporary protection for the wound.

### Effects of Extreme Cold or Freezing.

Just as in burns and scalds, we distinguish here also three different degrees, namely, the simple reddening of the surface, the formation of blisters, and the complete death of the parts.

The color of the reddened skin in cases of freezing is somewhat different from that produced by a burn. While, in a burn, the color of the skin is of a bright red, indicative of a disturbance in the arterial territories of the circulation, a sign of active inflammatory congestion, in frozen surfaces we find that the skin has a bluish-red color, which is indicative of a disturbance in the venous circulation and a sign of passive congestion and retarded return-circulation. Consequently the parts lack the local heat

and pain which we find in burns, and are, on the contrary, cold and devoid of all sensation. There is no sign of inflammation to be found anywhere about a frozen area, but instead we find oedema due to the existing passive venous congestion.

The second degree, or that of the formation of blisters, is developed slowly and not suddenly as in burns; the blisters are not so dense and so prominent as in burns, but rather flat and filled with a dirty white exudate consisting of serum and blood.

The third degree also is slowly developed; the parts dry up, turn dark brown and put on a mummy-like appearance.

*Death by freezing* occurs not only in the coldest regions of our earth but also in the moderate zones. When men have become very much exhausted by thirst, hunger and long marches, or are benumbed from having too freely indulged in alcoholic drinks, the prolonged influence of intense cold may go so far as to give rise to the formation of ice in the interior of our bodies, causing the fluids of them to turn solid. The tissues are thereby rendered stiff and brittle, losing at the same time their sensibility; such persons are overcome by an irresistible desire for sleep, which is quickly followed by death unless assistance is very near and prompt.

In drunkards, very much under the influence of liquor at the time, a cold wind, blowing on them for a long time, has been known to produce unconsciousness. In such persons you would find the entire surface pale and cold; the nose, mouth, hands and feet are of a bluish-red color; the pulse cannot be felt and breathing has almost or entirely ceased; the limbs are stiff and cold and devoid of all sensation.

The greatest possible caution is required in all attempts to bring such persons back to life; they must, first of all, be treated with cold, for sudden thawing would mean sudden death of the affected parts, hence avoid carrying them into a warm room immediately. If you carry the person or persons into any room at all, let it be cold by all means; their clothes should be cut off, not pulled off, and they should be rubbed with snow or very cold water; give them a cold general bath, if possible, and continue the rubbing in it. At last they may be lifted into a cold bed and covered up with some light things. The whole process should be slow and gradual and the external application of heat altogether avoided.

Internally the administration of cold brandy and, towards the end, of lukewarm tea is admissible.

If at any time during the course of treatment pursued by you it should happen that an unusual redness of the face and heat of the skin supervene, that headache comes on, with spots appearing in front of your patient's eyes, you must at once return to treatment with ice or very cold water.

If after a certain time no reaction occurs in the frozen parts, no normal warmth returns, no sensation reappears, the chance for a final return of life in them is very small.

The parts of the body most exposed to and most frequently attacked by frostbites are the nose, ears, fingers and toes.

## Foreign Bodies.

Foreign bodies, so called, may become lodged in the different parts of our bodies in many various ways; they may enter through natural passages or get in through the skin in a more direct way, as through wounds. But most often they pass in through the nasal passages, through the external ear, the eyelids and the mouth.

Foreign substances having penetrated into the intestinal canal or bladder can, of course, be removed only by the surgeon.

The nasal passages consist of three rather complicated tubular cavities arranged on either side of a medium, straight partition or septum, one above the other. Things may get into them in front or from behind; these accidents happen most frequently to children who, without thinking of the consequences, will introduce peas, beans, cherry-stones, etc., while playing; more rarely it happens that certain contents from the stomach get in from behind during the act of vomiting. Whenever the object has been pushed in from in front and not very far beyond the external openings, it may be seen by a tilting up of the point of the nose under a good direct light; if it is deeper, a nasal speculum may be required to bring it into view. If it is far enough forward so it can be seen, simple bilateral compression of the nose is sometimes sufficient to expel the intruder, or a sneezing attack brought on by tickling will do it; if, however, the object is deeper, a more effectual remedy will be a rubber tube about a foot or two long; this tube is introduced into the free nasal passage and there secured as nearly as possible air-tight by outside pressure with the fingers. A sudden powerful blow from the other end of the tube

in your mouth will generally bring forth the offender. When not too far in, fruit seeds and other smaller things have also been successfully removed by hair-pins slightly bent to suit the case. In all these cases the head must be held steady by an assistant.

In the ear passages all sorts of small objects are sometimes found, but most frequently insects. The passage is about one inch in length, partly bony, partly cartilaginous. Both portions being joined together at an obtuse angle, this must be overcome, the passage straightened out so as to render inspection easier; this is easily done by pulling the ear outwards and backwards.

Here you must avoid all manipulating with hair-pins, tooth-picks and other sharp instruments which might prove very dangerous. The best method for you to adopt is that you make an attempt to dislodge the foreign body by means of a good stream of water. For this purpose, pull the ear outwards, introduce the nozzle of your syringe on the floor of the passage so as to direct the water underneath the foreign body and cause it to accumulate behind it, then make a forcible injection and the object will fly out. If success should not crown your first efforts, you must not be discouraged but repeat the maneuver.

Hardened ear-wax must first be softened up by oil before it can be washed out by irrigation.

Insects in the ear are best dealt with after the following manner: Lay your patient's head on the table, the sound ear, of course, touching the table; then introduce a sufficient quantity of oil into the other ear, so as to completely fill it, and the insects must rise to the surface because unable to breathe in oil.

We all have experienced the unpleasant sensations caused by the presence of small insects, particles of dust, etc., in our eyes; fortunately, they rarely get any further than the conjunctival sac, and most of them may be gotten rid of by rubbing the closed eye in the direction towards the inner or nasal corner of the eye, where they are swept by the aid of the naturally increased flow of tears. If, however, this little maneuver does not succeed, then the eye-lids must be turned out, first the lower, then the upper, and the object removed by means of a soft handkerchief or a moistened camel's hair pencil. In case of lime having gotten into the eye, keep all water out of it, but drop some oil into the eye.

It happens not infrequently in machine shops that very small pieces of iron get into the eye, and very often, too, they will be

found seated somewhere on the transparent cornea, giving rise to the most unpleasant sensations. When on hand immediately after the accident, a good magnet is the surest means of getting them out, but later on it will require more skill than a first-aid-man would care to engage in.

All kinds of foreign substances have been known to become lodged in the throat and stomach tube. In these cases, the first-aid-man can do two things, namely, either induce vomiting by tickling the throat with a feather or finger, or cause the object to pass on into the stomach by making your patient swallow a big bolus of something like bread or boiled potato. Even if the foreign body were already in the stomach, boiled potato would be a good thing to eat, because well intended to round off sharp edges and corners, which will materially aid its passage onward through the intestinal canal and prevent wounding it.

In case leeches were swallowed, which sometimes happens when water is drank hurriedly and perhaps in the dark, strong solutions of kitchen salt must be at once administered.

Splinters under the skin and finger-nails must be removed by means of a fine pair of pincers, and should be withdrawn in a direction opposite to that in which they entered. Very fine splinters sometimes get under the nails and then break off beneath the nail and no pair of pincers are fine enough to get hold of them; these may be easily removed with the point of a needle.

Punctured wounds caused by rusty nails must be treated like poisoned wounds and under strictly antiseptic precautions, otherwise suppuration, if not lock-jaw, might follow the accident.

In cases of stings from bees and hornets, the external application of ammonia to the parts is indicated to neutralize the irritant fluid substances introduced by the insect; if inflammation should follow, cooling lotions must be applied, of which the ordinary lead and opium wash is the best.

You may some day be called upon to remove a ring from a finger that is very much swollen up. To avoid complications of this sort, it would be, of course, very much better if every one would remember in case of injury to his finger, that all rings on that particular finger should be removed immediately, before any swelling has set in. Swelling having set in, however, the ring must be promptly removed, since death of the entire finger by strangulation might result if left on.

The ring might perhaps be cut, but that requires instruments of a certain kind that are not always on hand and certain men who may not be found right off. In such a dilemma you must begin by trying to reduce the size of the finger first. With this end in view, take an elastic band and firmly apply it to the swollen finger, beginning at the tip and carrying it to where the ring is. This may be repeated several times if it should not work well the first time. The finger being now considerably reduced in circumference, a little oil is put on and the ring removed with the greatest of ease.

This process, however, would be admissible only when no suppuration complicates the case, because otherwise septic matter would surely be forced into the lymph vessels and blood poisoning result.

## Drowning.

When a man falls into the water knowing he cannot swim, he generally gets so bewildered that all the efforts which he makes, frantic as they are, to save himself are directed to no purpose whatsoever and the energy which he expends is consequently wasted.

In a good swimmer, on the contrary, the very consciousness of his ability to swim keeps him perfectly cool and self-composed, and enables him to save himself and others from drowning without unduly wasting a particle of his much needed energy.

While all of you perhaps know how to swim and swim well, too, it may happen some day that the odds are very much combined against you and you become exhausted before reaching your goal and before more substantial assistance can reach you. Under such conditions and circumstances, remember these few and simple rules, which, nevertheless, may keep you from drowning: (1) Lie on your back, with the head well backwards; let the mouth and nose be the only parts of the body that are above the surface of the water. (2) Keep your lungs full of air by taking deep inspirations and short, quick expirations. (3) Leave the arms under water, as shown in fig. 77.

The fact that the human body will float when in this position depends on its being very slightly lighter than the volume of water which it displaces. When, therefore, the arms are held above the surface of the water, the head must sink, owing to the loss of displacement (see fig. 78).

FIG. 76.—Arm showing different degrees of burns.

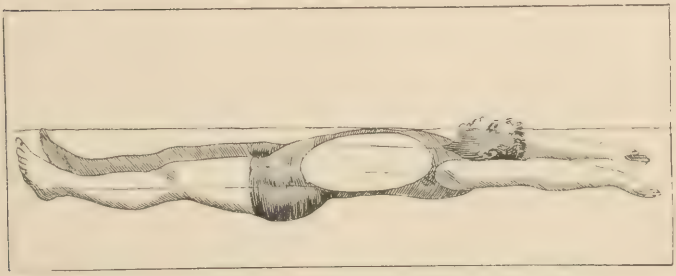


FIG. 77.—Showing how to keep horizontal position when floating in water.

FIG. 78.—Shows how head sinks below surface of water when hands are kept above the surface.

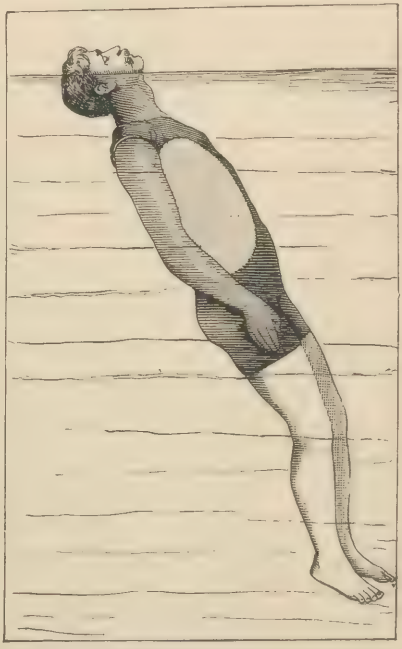


FIG. 79.—Shows position which the body assumes under water when hands are kept alongside of it.

The practice of this little maneuver should always form the first lesson in the art of swimming. The two best positions to be taken while floating in the water are represented in figures 77 and 79. When the arms are kept above the head, the position will become a horizontal one; when, on the other hand, these are kept alongside of the body, the position of the body in the water will incline towards the vertical (see fig. 79).

This is easily explained and understood by a glance at these pictures. The white oval space is made to represent the air contained in our lungs and which, therefore, answers the purpose of a swim-bladder; this space is very nearly in the center of the body whenever the arms are held above the head, and hence the horizontal position in the water; with the arms alongside of the body the greatest weight falls below this space, hence the position inclining more towards the vertical. In the vertical position the head must be bent further backwards than in the horizontal position in order that the mouth shall come to lie out of the water.

Whenever a man falls out of a boat into the water, an oar, boat-hook or rope may be passed him; a good little device also is your coat which you may take off, passing the man in the water one sleeve while you hold on to the other yourself.

According to Hans Mueller, a very celebrated teacher of swimming in Hamburg, Germany, and quoted by von Esmarch as having saved over 200 people from death by drowning, consequently well qualified to speak on the subject, the best method of saving life on the water is as follows: Before taking hold of the drowning man call out to him loudly that he is saved, in order to reassure him; approach the man from behind, passing your left arm between his left arm and body and seizing his right wrist and, in this manner, swim ashore on your back, striking out with your right free arm. The man is thus prevented from paralyzing your efforts by taking hold of you, which might be the cause of both drowning together. In case, however, the drowning man has seized the swimmer, the best thing the latter can do is to dive under until the former begins to lose consciousness and thus loosens his grip.

Whenever the tide is against you it will be best to float on your back with the tide and not exhaust your energies by trying to swim against it, and quietly wait for assistance to arrive.

Whenever any one breaks through thin ice, as is frequently the case during the skating season, and he is unable to extricate himself, the best help will be a long ladder or board intended to distribute the weight over a larger surface of the ice and upon which the boy may crawl out. Another very good means is said to be a wooden ball, such as is used in bowling, made fast to a rope and rolled out to him until it drops into the water; to this he can cling until further assistance arrives (fig. 80).

In approaching a man broken through weak ice, you must take the precaution either of crawling up to him on your stomach or at least arm yourselves with a long pole or boat-hook, which you must hold to your back with your elbows, as shown in fig. 81.

Death under water may be produced in two ways:

1. By suffocation, through water getting into the lungs.

2. By fainting.

Whenever death is brought about by suffocation, the face of the drowned person will present a puffed-up, swollen appearance, the skin of his face will be of a dark bluish color, particularly noticeable about the lips and eyes; there will, furthermore, also be a good deal of water found in the stomach and the lungs.

In cases of death by fainting, the face will look pale and there will be no water in the lungs, the spasmodic closure of the glottis over the wind-pipe having prevented its entrance there. It is much easier to revive one of the latter class than one of the former.

However, every drowned person ought to be looked upon as only seemingly dead, because it has happened that persons were brought back to life even after remaining under water for hours.

Attempts at resuscitation should be undertaken and conducted with confidence and perseverance and continued for several hours.

The following rules are borrowed from Prof. v. Esmarch's "Erste Huelfe," their observation is recommended to all whose duty it may become to save a drowning person, the rules themselves having been adopted by the German Samaritan Association. They are:

1. As soon as the drowning person arrives on shore send for a physician, for woolen blankets and dry clothes; take off all the wet ones.

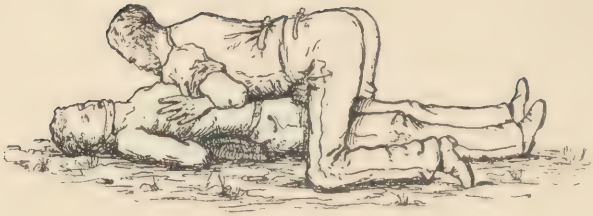
2. At once begin with your efforts at resuscitation, if possible in the open air, weather, of course, permitting.

3. Always remember your first duty to be the re-establishment of his breathing.

FIG. 80.—Trying to save a person broken through the ice by means of a wooden ball attached to a rope.

FIG. 81.—Manner of approaching a person broken through weak ice.

FIG. 82.—First step in the resuscitation of a drowned person.



A

FIG. 84.—Howard's method.

B

FIG. 84.—Showing Howard's method.

FIG. 85.—How to push the lower jaw forwards.

A

B

C

FIG. 83.—Illustrating the different steps in Sylvester's method of resuscitation.

4. Efforts at resuscitation must be kept up for hours before hope is given up.

5. Never stand the drowned man on his head; place him over your left knee with his stomach downward, pressing on his back so as to give the water a chance to run out of his lungs and stomach (see fig. 82).

6. Clean out his mouth with a small swab and also his nose so as to allow air to enter; if the tongue falls backward, pull it out, taking hold of it with a handkerchief.

7. Tickle the nose with a feather, try the effects of smelling-salts or ammonia water; rub his face and chest alternately with hot and cold water.

8. If no success follows these means, commence at once to make *artificial respiratory movements.*

9. The object of these movements is to expand and compress the chest alternately so as to force fresh air into the lungs.

10. The method recommended most is Sylvester's.

11. Put your man flat on his back, a folded blanket or coat supporting his shoulders.

12. Take your place behind him, seize both his arms near the elbows, raise them over his head, holding them in this position for a couple of seconds, as shown in fig. 83 *a*, thereby expanding the chest and forcing air into the lungs.

13. Thereupon return the arms to the side of the chest, press the elbows against the chest gently but firmly for two seconds, thereby pressing air out of the chest (fig. 83 *b*).

14. When two people are present, each may take one arm and the two work together (fig. 83 *c*).

15. These movements should be repeated at the rate of 15 times per minute and kept up until voluntary respiratory movements occur, generally announced by the red color returning to the man's face.

Another method recommended is that of Howard and illustrated in fig. 84.

16. The drowned person is placed on the back, the arms crossed behind, and a folded coat supporting the small of the back.

17. An assistant pulls out the tongue or pushes the lower jaw forward, as shown in figure 85.

18. The hands are laid flat on the lower part of the chest, and firm and steady pressure is made and kept up for two seconds.

19. Then the hands are raised, the chest expands.

20. As soon as voluntary inspirations commence, help the circulation along by hot blankets.

21. Rub the legs and arms from the periphery towards the center, as in massage.

22. As soon as both respiration and circulation have become re-established, put your man into a warm bed, surrounding him with hot bottles.

23. Finally, administer hot drinks, such as coffee, tea, etc.

These same methods of resuscitation can, of course, be applied also in cases of suffocation caused by the inhalation of poisonous gases.

## Unconsciousness

Is a condition characterized by the loss of consciousness, of general sensation and voluntary movements. It may be due to a number of causes, namely: 1. Injuries to the brain. 2. Diseases of the brain (epilepsy, apoplexy). 3. Temporary anemia of that organ from loss of blood either internally or externally. 4. Difficult respiration. 5. Sunstroke. 6. Poisoning by alcohol and other narcotics.

In the treatment of the condition of unconsciousness two cardinal rules with regard to the position of your patient must be kept in mind. (1) Whenever your patient's face looks pale, the position which you must place him in is the horizontal one. (2) When, however, his face looks red, as will be the case in apoplexy, then you must raise his head and trunk and place him in a half sitting position.

In the one case you are dealing with a case of anemia of the brain, and the horizontal position is the best in this case because it facilitates the re-establishment of the circulation through the organ. In the other you have either congestion of or hemorrhage into the brain, and the horizontal position would aggravate these conditions, hence you must elevate the head and trunk.

Smelling bottles, ammonia and ether, etc., much used in fainting fits, are directly contra-indicated in cases of congestion of or hemorrhage into the brain, in other words, in cases of apoplexy.

Moreover, when finding a person struck down in the streets, never forget to take a few mental notes of the position the person was in when found by you, for this may prove of considerable importance from a medico-legal point of view.

If the man begins to vomit, turn him over on his side with the face downward, so as to prevent any of the contents of his stomach from being sucked down into the wind-pipe and the lungs, which is a frequent cause of pneumonia. The vomiting over, swab out his mouth.

An epileptic may be allowed to lie on the ground until the fit is passed; he only requires watching so as to keep him from injuring himself. Consciousness soon returns, accompanied by great fatigue; these patients never have the slightest recollection of what happened during the attack.

## Sun-Stroke or Heat-Stroke.

The prolonged influence of solar heat on the more exposed portions of the surface of the skin is followed by inflammation and, may be also, the formation of blisters.

Sunstroke is a form of unconsciousness caused by hard work in an atmosphere which is overheated and oversaturated with moisture, aided by a scarcity of drinking water. Soldiers compelled to march in closed ranks for a long time often fall victims to sunstroke.

Sunstroke may be caused not only by the direct rays of the sun but also by radiated heat.

We distinguish two forms of sunstroke or heat-stroke, namely, (1) The *grave* form, which is characterized by paralysis or the suspension of all the cerebral functions, including respiration, and which is invariably followed by death. (2) The *mild* form, which frequently occurs in places where water is scarce, and is due as much to loss of water through perspiration and the consequent thickening of the blood as to the influence of the heat.

It is a good rule to take large quantities of water while at work in hot weather.

The mild form of heat-stroke commences with extreme drowsiness, stupefaction, cramps, severe headache and back-ache, difficult breathing, dark red color in the face, dry tongue, dry skin and feeble pulse.

Any person showing such symptoms had better at once be taken to a cool spot, his clothes taken off, ice applied to the head and lukewarm drinks administered; if convenient, give him a lukewarm bath to encourage perspiration; afterward put him in a wet pack.

Lightning either produces enormous burns, in some cases completely charring the parts struck, or it causes paralysis of the nervous system through the electricity which it sends into it, and the effects of which are most difficult to treat.

### Apparent Death.

The condition of apparent death from real death may be distinguished as follows: 1. By electrical currents passed through the different regions of the body; the electrical excitability ceases but a very short time after death has taken place. 2. By taking the temperature in the rectum; anything below 80° F. indicates sure death. 3. By winding a string around one of the fingers; as long as the peripheral portion of the finger swells up and assumes a bluish color under this treatment, and the white place, after removing the string, turns red again, death is not real but only apparent. 4. Irritants applied to the skin, in apparent death, are not followed by blisters with a red basis, but only by elevations of the cuticle having a white ground.

The treatment of apparent death must, of course, depend on circumstances.

## LECTURE VI.

### THE TRANSPORTATION OF THE WOUNDED.

The best method of transporting the wounded from one part of a modern man-of-war to the other must be considered still as an open, unsettled question. Perhaps there is no one best method at all, and every new ship requires a new method and new means to this end, owing to its own peculiar construction, just as every injury may require its own peculiar handling and form of apparatus.

However this may be, the problem must have appealed to the good sense of many an able medical mind as being an important one, if the number of cots that have been designed for the transport of the injured on board ship form any criterion to judge by.

Most every man-of-war has on board at least one or two of these relics of past ingenuity, which are, however, far from answering the purposes for which they were originally intended; they all prove that the necessity for something of the kind was nevertheless felt sufficiently strong to arouse even the most phlegmatic minds into a state of productive activity.

But granting even that every one of these different cots is very good and useful, the question might still be asked, what is the use of even the best of cots without trained bearers to handle it?

The best gun in the world would be perfectly useless without the men trained to work that gun, while an inferior one might be made to do good work under the pressure of circumstances with properly trained hands and minds behind it. Just so with the handling of the wounded and the cot.

The first and most important step, therefore, that must be taken to bring about some much needed reform in this much abused and neglected department aboard ship, is to train men.

We hold that it is not the most useless and the most stupid landsman that can be found among a crew whom you would

select as the proper person to aid you when wounded or in danger of life or in sickness. Why, then, thrust him onto others?

The surgeon on board ship and his patients need, on the contrary, intelligent assistants; hands, minds and hearts that are trained in the gentle duties required from such persons holding similar positions on shore.

But it requires some knowledge and experience in matters medical, as well as in life on board ship and its possibilities, to fully see and realize how imperfect a modern fighting machine like some of the present men-of-war appear in the eyes of a naval surgeon who is mindful of the duties and responsibilities of his position, without much better arrangements being made for the care of the sick and the transportation of the crippled and wounded.

And, by arrangements, we refer not to space alone, which may be ample and yet wasted.

In some of the more modern ships the constructor seems to have entirely forgotten that it is within the range of bare possibility for accidents and sickness to occur among the crew during the natural life of his ship.

A man-of-war without any provision for the sick and wounded may indeed go out and fight his battles, so might a man without his left arm or in the last stages of consumption; neither the ship nor the man will, however, in the long run, be able to compete with his more perfectly equipped adversary and must be considered crippled to that extent.

It is not the expenditure of necessary life which we mean to save; it is the waste and unnecessary expenditure of lives which it is our aim to prevent.

The matters of fact are indeed simple and clear and scarcely need any argument, as you will readily concede.

No matter, then, where a man may have been injured, whether on land or sea, the fact remains that, after dressing his wounds, it becomes the duty of the first-aid-man to employ or improvise means for his safe transportation to a place where he may receive further treatment.

The different methods of lifting and carrying the sick or injured must vary according to the nature of the case and the number of persons available for the purpose.

(1) There are cases of injuries which do not disable any one

from walking, and such persons need, therefore, no transportation at all.

(2) When the injury has occurred to the foot or the parts below the knee, the patient may, if of light weight, be conveyed pick-a-back, putting his arm around the neck of the bearer; but this would, very naturally, be impossible if the injury were in the upper part of the leg, on account of the pain it would necessarily entail.

(3) If the patient is suffering from some injury to the upper part of the leg, is unable to walk and yet perfectly sensible, he may be greatly assisted by the bearer placing his hip against the patient's hip on the uninjured side and taking the arm of the same side, placing it around his own neck and holding it there with one hand whilst his other hand and arm encircle the patient's waist. Then, by a series of light hops, the patient can be quickly moved along and the injured limb kept well off the ground (see fig. 86).

But circumstances may be such as to require you to move unaided an insensible person.

The method that is most frequently used in such cases is the following: The insensible person is put flat on the face, with the arms extended in a line with the body, and then brought into a kneeling position. The bearer places his right shoulder against the center of the body while placing his right arm between his legs and around the right thigh; at the same time he seizes the left wrist with his left hand, taking it around his own neck and under his left arm, passes it to the right hand which grasps it by the wrist. This may be done in the reverse way and the right arm left disengaged.

(5) A slight modification is sometimes adopted as follows: The patient, lying as before, extended and flat on his face, is raised to the kneeling position by the bearer, who stands in front, putting one arm in each arm-pit. He then slips his hands and arms around the patient's waist and brings him into the erect posture with his head hanging over the bearer's shoulder. Then, grasping either wrist and passing it over the head to the opposite shoulder, he slips under the body and swings it over his shoulders, grasping the legs with the opposite hand.

(6) Another method is to place the patient in a sitting position and to pass a soldier's belt or any broad continuous strap behind the thighs and under the arms. The bearer then seats himself

*dos-à-dos* and, passing the strap over his own forehead, raises himself. The weight will then fall upon the shoulders and upper part of the back. The strap under the arm will prevent the patient falling out, as he will be somewhat wedge-shaped, the broader portion above and the apex formed by the buttocks below. Both arms of the bearer are then disengaged and, therefore, this method is a good one in cases that occur on board ship while in motion.

When two bearers are available things are much easier.

(1) The ordinary dandy or sedan-chair, as made by children clasping their wrists as shown in fig. 87, is, of course, well known to you. This is only adapted when the injured person is sensible, as he must support himself by placing his arms around the necks of the bearers on either side of him.

(2) Another four-handed seat is sometimes made by the bearers crossing their arms and then taking each other's hands (fig. 88); but this is a bad one and not to be countenanced, because, if the patient is at all heavy, it soon becomes most painful to the bearers at the point where their arms cross, and they will have to put the patient down to relieve themselves.

(3) Also the bearers may lock only one pair of hands under the thighs of the patient and place their other arms around his loins, while he supports himself by placing his arms around their necks. This, again, is not so good as the first described.

(4) If the patient is not in sufficiently good condition to be trusted to supporting himself, the three-handed seat should be used, as represented in fig. 89, and then the bearer whose hand is left free places it upon the shoulder of the bearer whose two hands are engaged and thus a back is formed to the seat.

(5) A seat, but not as good a one as that just described, with a back to it, may be made by the bearers locking opposite hands under the thighs and placing their other two hands on each other's shoulder, as shown in fig. 88.

(6) Two bearers may convey an insensible person by one (the stronger) of them lifting the upper half of the body by placing his arms under the arm-pits and locking his hands in front of the chest, while the other bearer goes between the patient's legs and, turning his back to the first bearer, lifts one leg of the patient under either arm, as shown in fig. 90; a third person supports the lower limb, should that be the part injured.

(7) If circumstances should make it desirable that the patient

FIG. 86.—How to aid an injured person single-handed.

FIG. 87.—The ordinary dandy or sedan-chair.

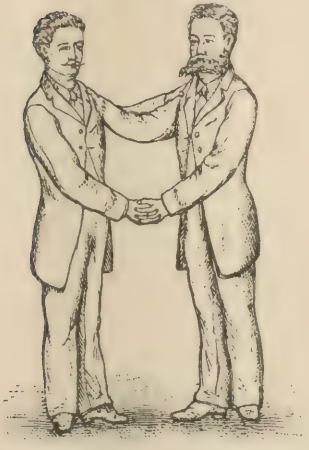


FIG. 88.—Another four-handed chair not so good as the sedan chair.

FIG. 90.—How two bearers may carry an insensible person.

FIG. 89.—Still another chair.

FIG. 91.—Manner after which an injured person is put on a stretcher.

be carried in a more extended position, the two bearers kneel down on their left knee only, and, passing their hands underneath the patient, lock them together. One pair of locked hands is placed below the shoulder-blades and the other pair below the buttocks. The bearers then rise gradually to their feet and move the patient by sideway steps, while his head is supported by a third person and the legs by a fourth. If only one other person is available, then priority should be given to the head if the patient is insensible, or to the leg if that is the part of the body which is injured. This is also the manner after which an injured person is put on a stretcher (fig. 91).

Then, as to the manner the bearers should lock their hands: this is usually done wrongly. The bearer on one side should notice which way the other is going to pass his hands under the patient, so that the bearer at the opposite side may pass his hands with the palms uppermost, while the other, passing his with the palms downwards, must keep close to the body of the patient, so that the bearer at the opposite side may pass his hands beneath the other one's. Their hands will then be clasped as shown in fig. 92, palm to palm, and held by the thumbs on one side of the wrist and the fingers on the other. This is the only right and proper way of joining the hands.

Whenever patients are to be carried some little distance, a stretcher should always be made use of.

The lifting of patients on to a stretcher and carrying them thereon by word of command is known by the name of *stretcher drill.* Every military organization the world over has its stretcher drill. Captain John Furley, the director of the St. John's Ambulance Association of London, has drawn up a system of stretcher exercises that are purchasable at St. John's Gate, Clerkenwell.

In connection with the stretcher drill, I must quote the words of Dr. Charles Smart, Surgeon and Major, U. S. A., and author of the Handbook for the Hospital Corps of the U. S. Army and State Military Forces, who says: "Drills by word of command are needful to perfect men in all movements that require concerted and co-operative action. It is a mistaken notion to suppose that because a drill is authorized and provided for, the various details of that drill must be rigidly observed on every occasion. The idea of seizing a man whose thigh-bone or spine is broken, or who has received some injury that must remain undiscovered until a care-

ful examination is subsequently made, and lifting him to or from a stretcher by word of command, is simply absurd. The drill is merely a means to an end. A well-manned battery keeps up a rapid fire on the enemy because every man at every gun knows the duty devolving upon him and does it without command at the precise moment when it should be done; but this perfection of co-operative work can be attained only by repeated and careful drills in the consecutive movements, each executed at the word of command. An analogous drill with the stretcher and a representative of the disabled human body familiarizes men with the management of these objects and prepares them to act intelligently, one with the other and irrespective of commands, when the necessities of the occasion require such action."

These words, in our opinion, express the *raison d'être* of the stretcher drill beautifully and forcibly.

The Drill Manual issued from the office of the Surgeon-General of the Army provides for the falling in of the men for inspection, drill, or active service, and prescribes the duties of each member of the squad in connection with litters, ambulances and other means or modes of transportation.

The detachment for inspection or drill is formed in single rank, privates of the hospital corps on the right, company bearers, without arms, in the center, and musicians on the left. The senior hospital steward is on the right of the line; the other hospital stewards and acting hospital stewards are posted as file-closers, two yards in rear of the line and in order of seniority from right to left. The formation, opening and closing of the ranks, maneuvering, inspection and muster of the detachment are effected by the commands and in the manner prescribed for infantry troops, modified in certain special details as follows:

1. After fours are counted in forming the detachment, if the knapsack or medicine-case men are not already in that place, they are assigned as No. 4 of each set. The sets of four or squads are numbered from right to left, and these numbers are not changed during the exercises. The left squad, if incomplete, may remain in line on the left and its men be afterwards utilized as dummy-wounded, or ordered to practice in transferring patients to litters or to beds or in improvised means for transportation; or they may be assigned as supernumeraries and posted on the line of file-closers behind the squads to which they are attached. Super-

numeraries are attached to squads when the duty to be performed promises to be so fatiguing as to require more than the usual reliefs.

(2) When one or more squads or the whole detachment is to be mounted, the detachment having been formed dismounted, the senior hospital steward gives the necessary directions, under the instructions he has received, for the squad or squads, or the whole detachment, to be marched to the picket line or stables for their horses and horse equipments. The mounted squads are formed in line in single rank, the lowest number squad on the right. A mounted hospital steward, specially assigned to this duty, or, in his absence, No. 1 of the right squad, superintends the formation of the mounted squads at the place designated. If the whole detachment is mounted, the senior hospital steward superintends the formation. The position of the stewards and acting stewards with detachments mounted are the same as with detachments unmounted, except that the file-closers are one yard in rear of the rank, the distance being measured from the croups of the horses in the line to the heads of the horses of the file-closers. If only part of the detachment is to be mounted, the instructor receives the report of the senior hospital steward at the formation dismounted; if the whole detachment is to be mounted he will receive the report of the steward mounted.

(3) At the command, *draw*—SWORDS, of inspection those armed with knives draw them and hold them in the position of *carry* SWORDS. Inspection of the knife is similar to that of the sword or saber. First motion: Raise the right hand as high as the neck and six inches in front of it, edge of the blade to the left. Second motion: Turn the wrist outward to show the other side of the blade, the edge to the right; make a slight pause and then turn the wrist back. Third motion: Drop the right hand to the side and hold the knife as prescribed after drawing from the sheath. At the command, *return* SWORDS, the knives are sheathed.

(4) Knapsacks, medicine cases and dressing boxes are unslung, opened, repacked and slung by the commands, and as nearly as practicable in the manner prescribed for the inspection of knapsacks or blanket bags of an infantry command. The company bearers take their dressing packets in the right hand and, as the inspector passes, they advance the hands so as to display the packets.

*Bearer Drill.*—In bearer drill the inspector designates by their numbers the squads which he wishes to operate with the hand-litters, ambulances, etc., and assigns the hospital stewards and acting hospital stewards to the superintendence of drills that are not supervised by officers. No. 1 of each set is the ranking member and gives the commands needful for the proper maneuvering of the squads.

No. 1 of a squad designated to practice with a hand-litter procures the litter and prepares it for use, placing it lengthwise on the ground, its near end opposite and two yards in front of the center of the squad; he then resumes his place on the right of the squad and commands:

1. *To your posts;* 2. MARCH. At the second command Nos. 2 and 3 take position between the handles—No. 2 in front, passing by the right, No. 3 in rear; No. 4 takes position on the left of the litter opposite its center and one yard from it; and when No. 1 has seen that the other numbers are in their proper places, he takes his own on the right of the litter opposite its center and one yard from it, all facing to the front.

Or, the folded litter being in position in front of the squad, at the command, *To your posts*, MARCH, the members take post, No. 2 on the right of the front handles, No. 3 on the left of the rear handles, and Nos. 1 and 4, respectively, on the right and left of the litter at its mid-length, all facing to the front. Then, at the command, *Open* LITTER, 1st, all face inward to the litter; 2d, Nos. 1 and 4 bend on the knee, grasp litter with hands under poles and rise erect, holding litter horizontal; 3d, Nos. 2 and 3 unbuckle and fix straps, adjust legs and straighten transverse irons, etc. Then, at the command, *Lower* LITTER, Nos. 1 and 4 lower litter to the ground, and all resume position as mentioned above, after the command *To your posts*, MARCH.

No. 1 now commands: 1. *Prepare to lift litter;* 2. LIFT LITTER. The first command is executed by Nos. 2 and 3, adjusting the braces about their shoulders; the second by the same members, raising the litter in position to be carried, Nos. 1 and 4 standing fast. If, owing to a difference in height of the carriers, the litter is not horizontal, No. 1 directs a change in the length of the braces to correct the inequality.

He then commands: 1. *Forward;* 2. MARCH, when, at the second command, the carriers break step, that is step off with

different feet, No. 2 with the right, No. 3 with the left foot, marching with the litter as nearly as possible horizontal and taking short sliding steps to avoid jolting and to secure a smooth, uniform movement of the litter; Nos. 1 and 4 march on their respective sides of the litter.

The litter is carried to the point previously designated by the proper officer by means of the command: 1. *Litter right (or left)*; or *Litter half-right (or left)*; or *Incline to the right (or left)*; MARCH.

To halt the litter and rest the squad, No. 1 commands: 1. *Litter;* 2. HALT; 3. *Lower litter;* 4. REST. At the third command, the litter is slowly and steadily lowered to the ground and the carriers release themselves from the braces; and at the fourth command, the men stand at ease in the vicinity of their posts.

To resume the attention the commands are: 1. *Squad;* 2. ATTENTION.

The transfer of a patient to a litter requires practice and the united action of two, three or all the bearers of a squad, according to the gravity of a wound or the helplessness of the patient. Every movement should be made without haste and as gently as possible, and the wounded part should be carefully protected from all injurious contact.

Having reached the sick or wounded man, No. 1 halts and lowers the litter so as to place it in front of the head or feet of the patient in the direction in which he is lying. As soon as the bearers are released from the braces, Nos. 2 and 3, passing by their right and left respectively, take position facing each other on opposite sides of the patient, near his hip-bones, and, if a limb be injured, No. 4 places himself by its side. Everything in readiness, No. 1 commands: 1. *Prepare to lift patient;* when Nos. 2 and 3 stoop down and get each one hand under the back of the patient near the shoulder-blades, and lock them by grasping firmly each other by the wrists; the other hands are passed under the upper part of the thighs and clasped; No. 4 attends only to the injured limb. No. 1 now commands: 2. LIFT PATIENT; when the bearers rise slowly and, when upright, as shown in fig. 91, at the command, 3. *Forward*, 4. MARCH, they move by short steps until the head of the patient is over the pillow on which it is to rest. No. 1 then commands: 1. *Squad;* 2. HALT; LOWER PATIENT; when the bearers slowly lower the patient on the litter.

Or the commands for marching and halting may be omitted, the bearers standing fast while No. 1 slips the litter under the patient.

Nos. 1 and 4 now see that the patient is in a comfortable position and perfectly secure, the head properly supported and the wounded part so placed that it can be easily attended to on the march.

The movements on the loaded litter are executed in accordance with the commands of the hand-litter drill as stated above.

It will be observed that, in raising the patient to the litter by this method, the head and upper part of the body are considerably elevated. An individual who is intensely prostrated may not be subjected to this treatment without risk of syncope. In such cases the following method is recommended by Smart:

When the litter has been halted near the head or foot of the patient, and in line with his body, No. 1 commands: 1. *Stand to wounded;* 2. *Right (or left)*; 3. MARCH. If *right* has been ordered, Nos. 2, 1 and 3 proceed by the right of the litter and range themselves along the corresponding side of the patient, facing him—No. 2 by his right knee or left shoulder, according as the head or feet of the wounded man point to the litter, No. 1 at his hip and No. 3 at his right shoulder or left knee, while No. 4 takes position opposite and facing No. 1. If left has been ordered, Nos. 2, 4 and 3 proceed by the left of the litter and range themselves along the corresponding side of the patient, while No. 1 takes position opposite to and facing No. 4. The accompanying diagram shows the positions of the bearers when the order is right (fig. 93). At the command, LOAD—using the numbers for the movement, *one*, the bearers kneel on the right knee if on the right, and on the left knee if on the left of the patient; *two*, No. 2 or 3, who is stationed at the patient's knee, passes both arms about the patient's legs, carefully supporting the fracture, if there be one, Nos. 1 and 4 pass their arms under his hips and loins, No. 2 or 3 passes one arm under his neck to the farther axilla, with the other supporting the nearer shoulder; if possible the patient clasps his arms about the neck of this bearer; *three*, all lift together, slowly, supporting the weight upon their knees, and as soon as the patient is firmly supported, No. 1 or 4, whichever is on the free side, withdraws his arm and passes by the shortest line to the litter, which he takes up near the middle, one pole in each hand, and returning to his

position, places it under the patient and close against the bearers, being careful to see that its legs are properly arranged, and then assists, as before, in supporting the patient; *four*, all the bearers gently lower the patient on the litter; *five*, the bearers rise and resume their position, 2 and 3 as carriers, and 1 and 4 on the right and left of the litter, respectively.

It will frequently occur that, being wounded in the leg or foot too severely to walk, the injured man can, nevertheless, with proper attendance, seat himself upon the prepared litter placed by his side and then lie comfortably upon it.

To change bearers on the march, No. 1 commands: 1. *Litter;* 2. HALT; 3. LOWER LITTER; followed by 1. *Change Posts;* 2. MARCH; when Nos. 1 and 2, and 3 and 4 exchange posts and duties, except that No. 1 retains command of the stretcher.

The transfer from litter to litter, or to bed, is effected in the same way as from the ground to the litter, the bearers always observing, as far as practicable, that the litter or bed to which the patient is to be transferred shall be at the head of the patient, its length in the direction in which he is lying.

As a general rule in hand-litter operations, the feet of the patient should point in the direction in which the litter is carried. But in going up hill or upstairs, the patient's head should be in front, unless he has a broken leg or thigh, in which case the order is reversed to prevent the weight of the body from pressing down on the injured part; and on the going down hill, the patient's head should be behind, except for the reason given in cases of fracture of the lower extremities. It is important that the bearers should keep the litter level, notwithstanding an unevenness of the ground. In making ascents, the stronger of the two bearers should be in rear, as he has to bear a greater weight in raising his end of the litter to the proper level, and in making descents he should, for the same reason, be in front. A breach should be made in a fence or wall for the passage of the stretcher, if there be no gate or other opening, rather than risk the passage of the injured man over it; but should it be necessary to surmount the obstacle, Nos. 1 and 2 place the front handles securely on top, while 3 and 4 elevate the rear handles; the two first-mentioned then cross the wall and advance the litter until its rear handles rest upon it, when 3 and 4 cross, resume the handles, and all lower the litter, after which the march is continued as before the obstacle was reached.

In crossing a ditch or deep cut, the litter is laid on the ground with the front handles near the edge; Nos. 1 and 2 descend and advance the litter, keeping it level, until the rear handles rest upon the edge, when Nos. 3 and 4, who have assisted in this movement, descend and resume the support of their respective handles; the ascent is made on the other side by Nos. 1 and 2 resting their handles on the edge, ascending and advancing the litter until its rear handles rest upon the edge, when Nos. 3 and 4 ascend and the march is resumed. The position of a patient on the litter depends on the site and nature of his injury. The head should be, as a rule, low, particularly when the patient is faint; but difficulty of breathing in penetrations of the chest often requires that the head and shoulders be elevated. In wounds of the abdomen the best position is on the injured side, or on the back if the front of the abdomen is wounded; the legs in either case being drawn up and a pillow or other suitable object placed behind or beneath the knees to keep them bent. In an injury of the upper extremity, calling for litter transportation, the best position is on the back or on the uninjured side, while in injuries of the lower extremity the patient should be on his back or inclining towards the wounded side.

To change the direction of the litter in order to ascend an elevation, when the patient's lower limbs are not fractured, or to descend an elevation when such a fracture is present, No. 1 commands: 1. *Squad;* 2. HALT; 3. *Lower litter;* 4. *About* FACE; 5. *Raise litter;* 6. *On* No. 2 (or 3) *right* (or *left*) WHEEL.

To fold the litter when the patient has been disposed of and the necessity for the open litter is at an end, the squad being at their posts, No. 1 commands *Fold* LITTER; when 1st, No. 2 steps to the outside of his right handle, No. 3 to the outside of his left handle, and all face the litter; 2d, Nos. 1 and 4 advance to mid-length of the litter, bend on the knee, grasp the litter with hands under poles and rise erect, holding the litter horizontal; 3d, Nos. 2 and 3 remove slings from handles and lay them across litter near its ends, close handles, legs and transverse irons, fold canvas lengthwise on top of poles, placing slings lengthwise on canvas, buckles out, and securing all by straps at ends. The litter is then lowered. At the command *Lower* LITTER, Nos. 1 and 4 lower the litter on the ground, handles on the right of Nos. 2 and 3, and recover the erect posture. The command *To your posts*, MARCH, brings the

squad to the position occupied before the litter was unfolded, after which, at the command *Front into line*, MARCH, 1, 3 and 4 advance to the line of No. 2 in their regular formation, 1, 2, 3 and 4 from right to left. The squad may then be rested or marched off in any direction without the litter or with it.

The foregoing description of the stretcher drill, adopted by our army, taken from Dr. Smart's "Handbook for the Hospital Corps," shows the drill to be simple, to the purpose and devoid of all unnecessary frills.

The adoption of the bearer drill of our army by the Navy would seem desirable from many points of view, but more especially so in the not impossible event of future co-operation of both branches of the service.

The stretcher is, fundamentally, the most important piece of apparatus used in the transportation of the wounded, whether on board ship or on shore. All other means of conveyance must be considered merely as modifications of the regular stretcher, and any one expected to improvise and extemporize means of conveyances for the sick and wounded in time of scarcity and need, must first have been made familiar with the principles underlying the practical management and construction of the stretcher, no matter what its form or description.

For use on shore and in hospitals the plain, ordinary stretcher, provided with legs, will always be found to be the best and most convenient as well as the safest means of conveying the sick and wounded. Such a stretcher can be carried by two men either by hand or by means of shoulder straps, the ends of which are slipped on to the handles. A change of bearers is easily effected and without having to lower the patient flat on the ground, which may be rough, uneven or wet. During all naval operations on shore, therefore, such stretchers, provided with legs to stand on, should, if possible, be used, and other means of conveyance extemporized when a sufficient number of regular stretchers are not at hand.

For purposes of handling and transporting the sick and wounded on shipboard several very ingenious cots have been designed.

Fig. A represents the ambulance cot invented by Dr. A. L. Gihon, U. S. N., with patient in position and ready to be lowered either into a boat or through a hatchway. As seen in the figure,

the cot consists of a wooden frame with a sheet of canvas stretched across, and with a number of canvas bands of different widths sewed on so as to secure the patient in position and prevent his slipping out in case of accident while being lowered through a hatch or down a ladder.

In cases in which the injury would be such as to necessitate the patient's being passed down a ladder head foremost, the shoulder straps can be easily and effectually so arranged as to prevent the patient from slipping in this direction also. Gihon's cot, therefore, seems to me a perfectly safe one and well adapted for use on board ship.

Fig. B shows the cot designed by Dr. A. C. Gorgas, U. S. N., in position and ready to be lowered.

As seen in the diagram, the thighs and legs of the patient are resting upon a leather-covered, double inclined plane which can be moved and adapted to suit the requirements demanded by special cases, while a narrow leather band is made to hold the upper part of the body in position and prevents it from slipping in a downward direction.

The so-called "Rapid Transit Ambulance Cot," made by the Walton Manufacturing Co., of New York, and invented and patented by Dr. H. M. Wells, U. S. N., is another very good cot for purposes of moving patients on board ship. This cot is constructed of stout canvas with thin hickory slats stitched in across the bottom, which give it sufficient stiffness laterally and permit it to adapt itself longitudinally to the form of the patient.

There are ten stout canvas handles on the sides for lifting, and the cot may either be carried straight or at an angle, as may be required by the particular disability of the case. It is also narrow enough to be passed down any ladder or along any gangway, and has no lateral projections; it can also be slung by the handles and raised or lowered by pulleys through any hatch.

Fig. 94, A, represents the cot rolled up, weight 10 lbs.; B shows how a patient may be carried at an angle; C, cot without poles; D, cot with poles.

The cot suggested by Lieut. T. B. M. Mason, U. S. N., belongs to the class of *extemporized* cots and simply consists of an ordinary ship's hammock stretched across and secured to a wooden frame. There are, indeed, times when no one single ready-made conveyance will answer the purpose and when a special one must be improvised.

FIG. 92.—Showing correct manner of clasping hands.

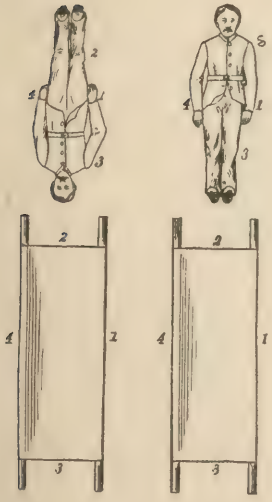



FIG. 93.—Standing to wounded by right.

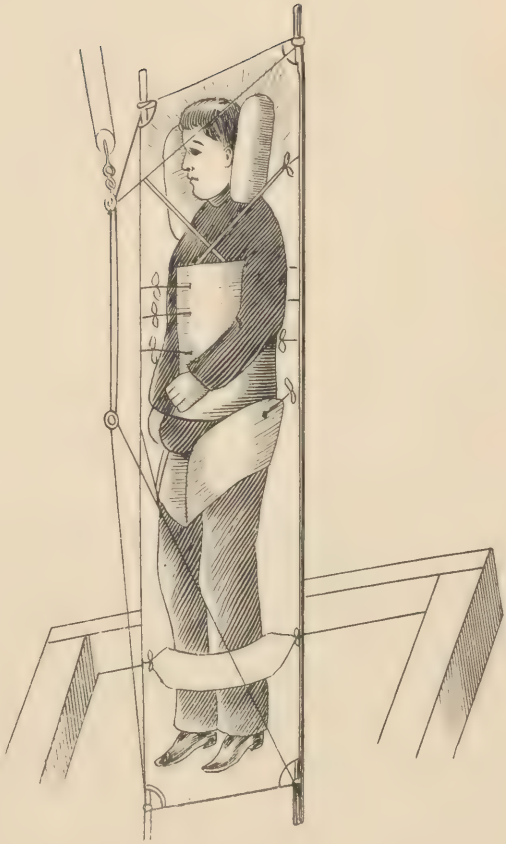


FIG. A.—Gihon's cot for ship's use; patient ready to be lowered through a hatch or into a boat.

FIG. B.—The Gorgas cot.

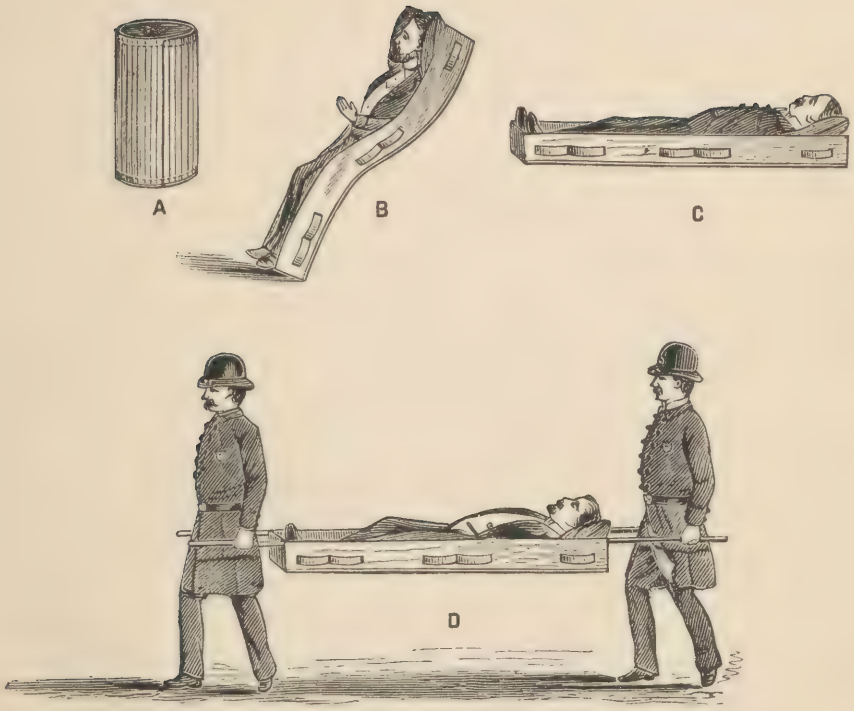



FIG. 94.—The Walton-Wells cot.

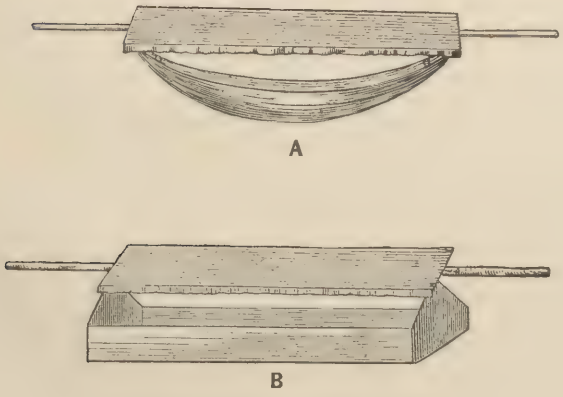



FIG. 95.—Extemporized cots.

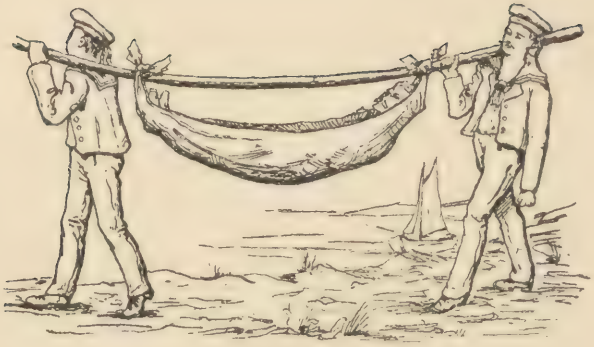


FIG. 96.—Extemporized cots.


FIG. 97.—(Notes in text.)

Hammocks and cots are always plenty on board every ship, and these may easily be converted into ambulance cots by being suspended from single poles, as shown in figs. 95 and 96, or they also may be changed so as to be carried between two poles.

The former plan was adopted during the late expedition of British troops in Western Africa, and Staff Surgeon H. Fegan, R. N., mentions that each hammock was fitted with a pillow made of another spare hammock, which in the event of an emergency could be easily slung from tree to tree and thus often proved very useful.

Any blanket, bed cover, traveling-rug may be converted into a hammock, as shown in figure.

For purposes of embarking or disembarking the sick and wounded where stretcher conveyance is not available or inapplicable, Dr. J. D. Macdonald, F. R. S., R. N., has designed an "ambulance lift" for ship or shore, seen in the accompanying figure.

FIG. 97.—AMBULANCE LIFT FOR SHIP OR SHORE.—REFERENCES TO THE FIGURE.

1. Hook or eye-bolt fixed to the beam over the hatchway.

2. A "double whip" or a purchase with a double block above and a single one below, *a* and *b*; *c*, the hauling part.

3. A span with an eye in the middle for the lower hook of the purchase.

4. A pole, 4½ feet long, with which the span is connected.

5. An ordinary hammock attached by the head and foot clews to the extremities of the pole and further sustained by lanyards, *a*, fixed to a hand piece, *b*, besides the leg. In cases such as these the cacolet bed has rendered excellent service. In order to prevent the shaking as much as possible it is desirable to make the patient sit or lie on pliant cushions, and for this purpose India rubber ones are recommended, which have frequently been made use of.

Two rifles and one or two coats, the sleeves turned in, make a very good temporary stretcher. The present working suits of our sailors used in the same way with two boat-hooks, would make a very solid stretcher, as will also several knapsacks or sword-belts. Figs. 98 and 99.

The means that are employed in making extemporaneous cots and stretchers must, of course, at all times depend upon where the accident will find you. The more thoroughly you are familiar with the principles of your work, with the aim and object you have in view, the more readily will you find such means as will answer your purpose.

Practical Exercises: Stretcher drill and extemporizing ambulance cots.

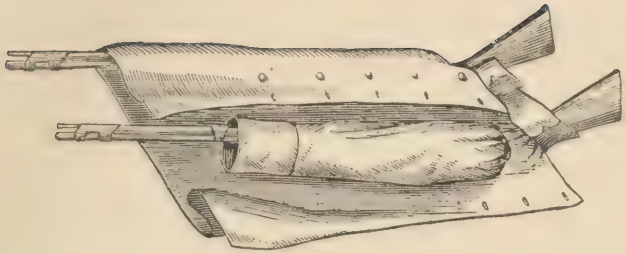


FIG. 98.—Extemporized stretcher.

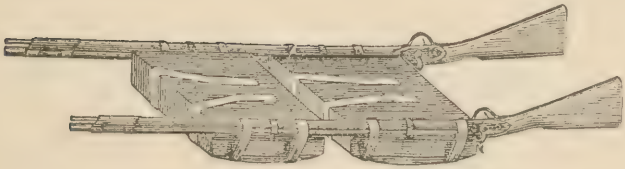


FIG. 99.—Extemporized stretcher.

FIG. 100.—Modified Indian travois for transporting the sick or injured over rough and mountainous roads.

# *SPECIAL NOTICE.*

## NAVAL INSTITUTE PRIZE ESSAY, 1893.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the Prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1893. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

5. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

6. All essays submitted must be either type-written or copied in a clear and legible hand.

7. The successful competitor will be made a Life Member of the Institute.

8. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of Board of Control.

H. S. KNAPP,
*Lieut., U. S. N., Secretary and Treasurer.*

ANNAPOLIS, MD., *March* 15, 1892.

# THE HOTCHKISS ORDNANCE COMPANY

LIMITED

**Paid-up Capital, - $5,500,000**

MANUFACTURERS OF

## Hotchkiss Light Artillery

## Howell Automobile Torpedoes.

### AMERICAN DIVISION.

MANAGING OFFICE: 1503 Pennsylvania Ave., Washington, D. C.
TORPEDO FACTORY: 14 Fountain Street, Providence, R. I.
GUN MANUFACTURERS: The Pratt & Whitney Company, Hartford, Conn.
AMMUNITION MANUFACTURERS: The Winchester Repeating Arms Company, New Haven, Conn.

### BRITISH DIVISION.

DIRECTORS' OFFICE: 49 Parliament Street, London, S. W.
MANUFACTURERS: Lord William Armstrong, Mitchell & Co., Newcastle-on-Tyne.

### FRENCH DIVISION.

MANAGER'S OFFICE: 21 Rue Royale, Paris.
FACTORY: Route de Gonesse, Saint Denis.

### STANDARD NAVAL GUNS.

Revolving Cannon.—1 pdr., 2½ pdr., 4 pdr.
1 pdr., 2½ pdr., 3 pdr.
Rapid-firing Guns.—6 pdr., 9 pdr., 14 pdr.
33 pdr., 55 pdr.

### STANDARD MILITARY GUNS.

1 pdr. Field Revolver. 2 pdr. Rapid-firing Mountain Gun.
Flank Defense Revolver. 12 " " " " "

Designs, estimates and material furnished for the complete armament of naval and auxiliary vessels. Complete batteries and equipments furnished for mountain and field artillery. Designs, estimates and material furnished for automobile torpedo outfits.

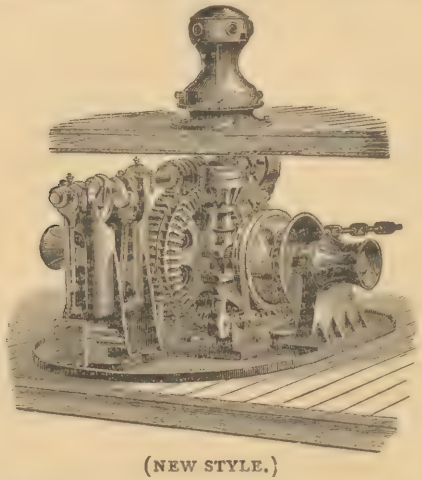
ESTABLISHED 1857.

# AMERICAN SHIP WINDLASS CO.

## Providence, R. I., U. S. A., Box 53.

Original and only Builders of the celebrated "PROVIDENCE" Steam and Hand Windlasses, and Steam, Crank and Power Capstans for Steam and Sailing Vessels, Yachts, Tugs, Wrecking Boats, Pilot Boats, Elevators, Dry Docks, etc. And also, Winter's Patent Hawse Pipe Stoppers, and Wharf and Ferry Drops.

THE "PROVIDENCE" PATENT STEAM CAPSTAN WINDLASS.



(NEW STYLE.)

The following United States Vessels have these Windlasses:

STEEL CRUISERS.

Chicago, Atlanta, Philadelphia,
Boston, Baltimore, Newark.

GUN BOATS.

Yorktown, Bennington,
Petrel, Concord.

Dolphin, Despatch Boat.

Vesuvius, Dynamite Boat.

U. S. NAVY.

Miantonomoh, Vicksburg,
Puritan, Adams,
South Carolina, Alliance,
Massachusetts, Essex,
Young Rover, Thetis,
Cambridge, Bear,
Coatzacoalcos, Transport.

U. S. COAST SURVEY.

Hassler, Blake.

U. S. LIGHTHOUSE DEP'T.

Haze, Dahlia.

U. S. REVENUE DEP'T.

Geo. M. Bibb, Oliver P. Wolcott,
Levi Woodbury, Walter Forward,
Warrington, Geo. S. Boutwell,
Lincoln, Com. Perry,
Gallatin, Dallas,
Hamilton, Ewing,
Seward, Fessenden,
Colfax, Manhattan,
Bache, Richard Rush,
Crawford.

U. S. FISH COMMISSION.

Albatross. Fish Hawk.

# Cluett's

## COLLARS and CUFFS

FOR GENTLEMEN.

CLUETT, COON & CO., Manufact'rs.




## CLUETT, COON & CO.'S

TRADE MARK. *Monarch* SHIRTS

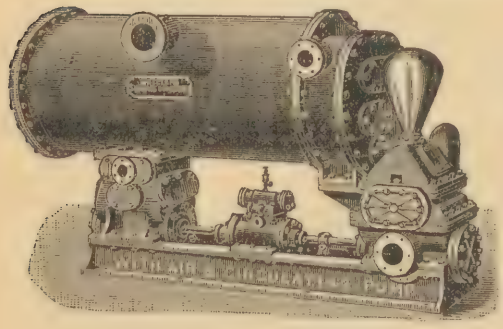
SOLD EVERYWHERE
WITH INCREASING POPULARITY.

SOLD BY THE NAVAL ACADEMY STORE.

# Wheeler Condenser & Engineering Co.

## 92 & 94 Liberty Street, New York,

Proprietors and Manufacturers of



WHEELER'S

IMPROVED

## Patent Surface Condensers,

ALSO THE

**Wheeler Admiralty Condenser, with Patent Screw Glands.**

The WHEELER SURFACE CONDENSER is used as a test condenser for the instruction of students in testing steam engines, in the Mechanical Engineering Departments of the following colleges: Stevens Institute, Massachusetts Institute of Technology, Sibley College, Iowa Agricultural College, Worcester Polytechnic Institute, Lawrence School of Technology (Harvard), University of Pennsylvania, University of Michigan, Pennsylvania State College, Purdue (Indiana) University, Toronto School of Practical Science, Agricultural College of Michigan, University of Illinois, and Rose Polytechnic Institute (Indiana).

---


THE GEO. F. BLAKE M'F'G CO.

BUILDERS OF EVERY VARIETY OF

## Pumping Machinery

95 & 97 LIBERTY STREET,

New York.

## Marine Steam Pumps of Every Description.

Independent Air Pumps and
Combined Air and Circulating Pumps a Specialty.

***Contractors for the outfit of Steam Pumps for the U. S. Cruisers New York, Detroit, No. 9, No. 10, No. 11, No. 12 and No. 13; also for Battleships Maine, Massachusetts, and Indiana; also for Gunboats Petrel, No. 5, and No. 6; also Dynamite Cruiser Vesuvius; also Harbor Defense Ram No. 1.

# Comparative Tests.

# Royal Baking Powder
## Purest and Strongest.

**Dr. PETER COLLIER,** late Chemist-in-Chief of the Department of Agriculture, Washington, D. C., having analyzed the chief brands of baking powder,

**Reports the Royal Baking Powder the greatest in leavening strength,**

Yielding over 27 per cent. more gas than the average of the others tested. Dr. Collier adds: "I have made many analyses of various brands of baking powders and

**"I have always found the Royal composed of pure and wholesome ingredients.**

**"Peter Collier, M. D., Ph. D."**

"April 2, 1892."

# NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twentieth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and of others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

## ARTICLE VII.

SEC. 1. The Institute shall consist of regular, life, honorary, and associate members.

SEC. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

SEC. 3. The Prize Essayist of each year shall be a life member without payment of fee.

SEC. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

SEC. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

SEC. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

SEC. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

---

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed, by the Board of Control, of use to the service, will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscription for non-members, $3.50. Annual dues for members and associate-members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.